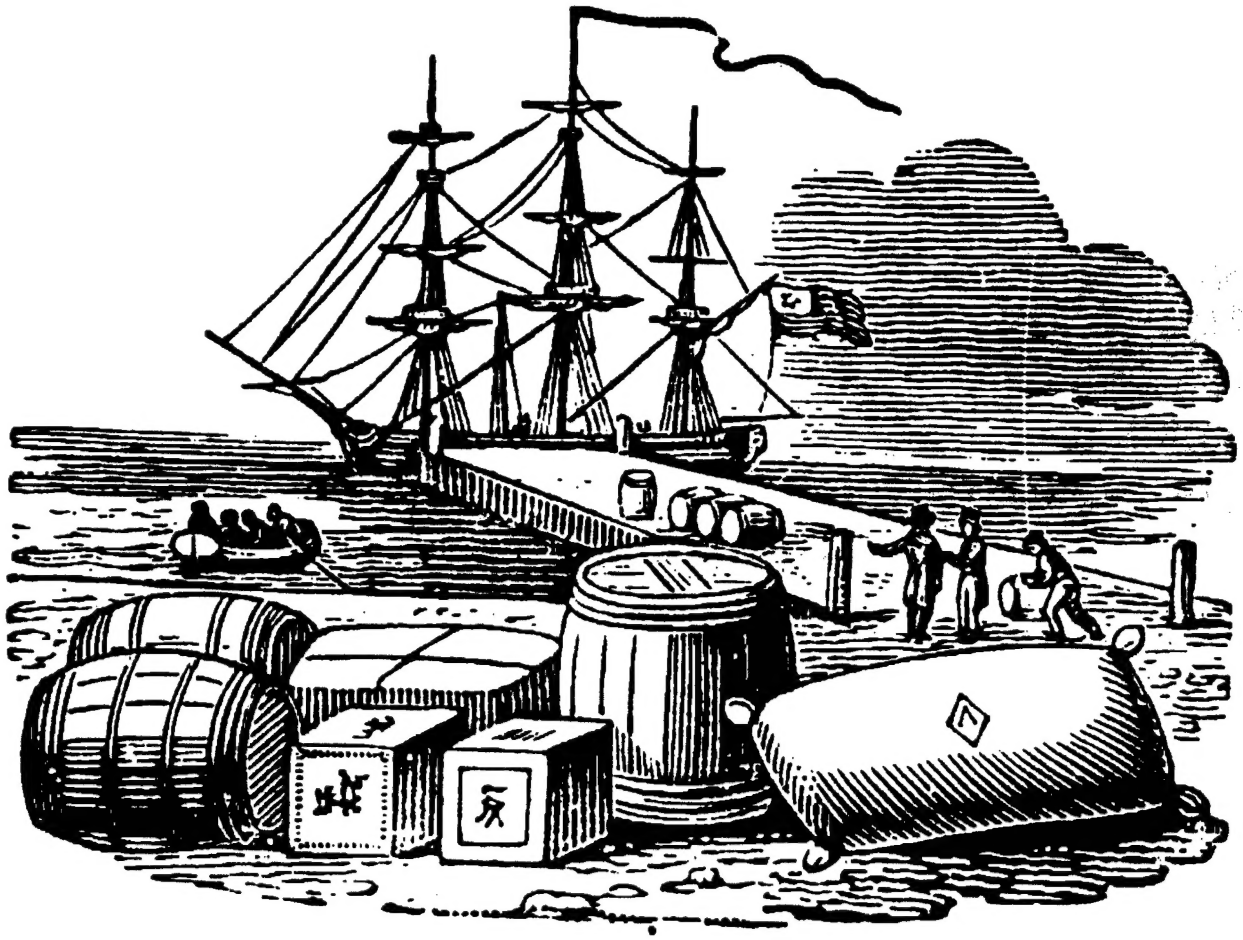
GULF COAST REGION MARITIME TECHNOLOGY CENTER

QUARTERLY REPORT



96 - GCRMTC - QR04

OCTOBER 1, 1996 - DECEMBER 31, 1996

GULF COAST REGION MARITIME TECHNOLOGY CENTER

QUARTERLY REPORT

REPORT PERIOD:
October 1, 1996 - December 31, 1996

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EXECUTIVE SUMMARY

The Gulf Coast Region Maritime Technology Center (GCRMTC) was initiated September 26, 1994 and has been designated as a Navy Center of Excellence in Advanced Marine Technology. The Center carries out research in advanced marine technology at both its New Orleans, Louisiana and Orange, Texas Sites. All research projects sponsored by the Center are collaborative research projects with marine industry partners.

The Center issues requests for concept proposals from maritime industries once per year and from internal sources twice per year. During this quarter the Center received 13 concept proposals which were peer reviewed, and then reviewed by the Government/Industry Advisory Board (GIAB). The GIAB, meeting on December 12, 1996, reviewed the concept proposals and made their recommendations to the Government Program Manager (GPM).

The Center operates two subcenters. The Environmental Resources and Information Center (ERIC) is co-located with the New Orleans Site and is a depository and resource for environmental issues of concern to the shipbuilding/marine industries. The second subcenter, the Simulation-Based Design Center (SBDC), is co-located with the Orange Site and has several collaborative projects ongoing with shipbuilding marine industries. The operations and services of the GCRMTC and both subcenters are fully detailed on the World Wide Web.

Status reports on 17 collaborative research projects being conducted at both sites are appended for reference. Status reports on four subcontracts with marine industries are also appended for reference. Several interim and final research reports have been issued on Center projects. All research projects funded through the Center are in collaboration with academic and shipbuilding/marine industry partners.

Five agreements have been executed with subcontractors under the auspices of the National Shipbuilding Research Program (NSRP). Two additional agreements are pending.

The GCRMTC participated in the Shipbuilding Machinery and Marine Technology Exhibition and Conference (SMM '96) in October 1996 as part of the U. S. pavilion. Dialogues and relationships were established with operators, contractors, and suppliers of the world's ships.

1.0 INTRODUCTION

The Gulf Coast Region Maritime Technology Center (GCRMTC) was initiated September 26, 1994, and is now fully operational. As part of the Center's mission, research is carried out at both the New Orleans and Orange Sites. The Center has been designated as a Navy Research Center of Excellence in Advanced Marine Technology.

The Center also solicits concept ideas for collaborative research from university sources as well as from maritime industries, and then issues Requests for Proposals (RFP) under the guidance and direction of its Government/Industry Advisory Board (GIAB) and the Government Program Manager (GPM). All research projects sponsored by the Center at both its Sites are collaborative research projects with marine industry partners.

2.0 CENTER ACTIVITIES

2.1 CONCEPT PROPOSAL SOLICITATION

The Center now solicits concept proposals twice a year from university sources and once each year from maritime industry sources. The concept proposals received are processed through an external peer review process. The results of the peer reviews along with Center recommendations are presented to the GIAB for ranking and recommendations to the Government Program Manager (GPM). The GPM decides which of the external and university concept proposals will be issued as RFPs.

Maritime industry proposals received in response to RFPs are reviewed by external peer reviewers, ranked, and submitted to the GPM for funding approval. University proposals are submitted to the GPM for funding approval.

Table 1 indicates the concept proposal solicitation dates, the number of university and maritime industry sources solicited, the total number of responses, the GIAB review date, the number and date of external RFPs and call for full proposals issued, and the number of proposals received and funded by the GPM.

TABLE 1. STATUS OF CONCEPT PROPOSALS

Concept Proposal Solicitations										Proposals		
Date	Sources		No. of Responses		GIAB Review	RFPs Industry		RFPs University		Rec'vd	Funded	Funding Pending
	Ind.	Univ.	Ind.	Univ.		Date	No.	Date	No.			
2/95	215	45	65	26	5/95	7/95	5	7/95	6	12	10	0
8/95	325	50	31	19	12/95	4/96	3	1/96	6	10	6	3
1/96	305	50	22	11	5/96	Pending*		6/96	6	6	4	2
7/96	N/A	50	N/A	13	12/96	Pending*		Pending*				

*RFPs in process, pending availability of funds.

A master schedule (Appendix A) depicts timeframes for both the RFP and concept proposal solicitations and other events pertaining to the Center and its New Orleans and Orange Sites.

2.2 SUBCONTRACTED RESEARCH

Based on the proposals submitted in response to RFPs issued in July 1995, subcontracts have been awarded by the GCRMTC effective June 1, 1996, and status reports are appended as shown in Table 2, below.

TABLE 2. SUBCONTRACTED RESEARCH

Contractor	Proposal Title	Appendix
Rockwell International	An Investigation of the Expansion of the GCRMTC Ships' Reliability, Availability, and Maintainability (RAM) Database	Q
M. Rosenblatt & Son, Inc.	Development of a Portfolio of Ship Designs	R
Cybo Robots, Inc.	Automated Off-Line Programming: A Strategic Tool to Link the Design and Manufacturing Processes	S
MACSEA Ltd.	Automated Machine Learning of Diesel Engine Operating Characteristics	T

Progress meetings were held in mid-December with each subcontractor, the GPM, and the Executive Director.

2.3 NSRP FUNDED PROJECTS

The Center recently executed five agreements in connection with the National Shipbuilding Research Program (NSRP). Two others are pending. The subcontractors and research topics are listed in Table 3.

TABLE 3. NSRP AGREEMENTS

Company	Topic
NASSCO	Application of industrial engineering techniques.
NASSCO	Develop leapfrog technology to standardize equipment.
NASSCO	Implementation and update of design for production manual.
NASSCO	Assist U. S. shipyards to develop/maintain skilled trades workers.
Avondale	Vendor-furnished information guidelines.

2.4 INTERIM AND FINAL REPORTS

The following table shows the status of the various GCRMTC interim and final reports. Abstracts of the published reports are posted on the GCRMTC web page at http://www.uno.edu/~engr/gcrmtc.html.

TABLE 4. STATUS OF INTERIM/FINAL GCRMTC REPORTS

Title (PI)	Type	Date To GPM	Status/Comments
Pigment Substitute for Chromium (Daech)	Interim	7/1/96	Published 11/96
Integrated Environmental Plan for Shipbuilders (Kura)	Interim	7/18/96	Pending GPM Review
High Speed Design Database (Latorre)	Interim	7/1/96	Pending GPM Review
Optical Fiber Sensor Systems (Lee)	Interim	7/1/96	Pending GPM Review
Shipboard Sensors (Trahan)	Interim	7/1/96	Pending GPM Review
RAM Database (Inozu)	Interim	7/1/96	Published 11/96
Performance Simulation of Marine Systems	Final	7/1/96	Pending GPM Review
Digital Photogrammetry	Final	7/1/96	Published 11/96
Structural Design Procedures (Mattei/Folse)	Final	8/5/96	Pending GPM Review
Software Applications for Shipbuilding(Whitley)	Interim	11/26/96	Published 12/96
Improving Technology Transfer (Lannes)	Interim	7/11/96	Published 12/96
Ship Capsizing (Falzarano)	Interim	7/1/96	Pending GPM Review
NBDL Motion Sickness (Dobie)	Final	11/27/96	Pending GPM Review
Business Process Improvement (Orange)	Final	11/4/96	Pending GPM Review
Ship Repair Market Study (Orange)	Final	11/27/96	Pending GPM Review
Japanese CIMS Translation (Orange)	Final	11/27/96	Pending GPM Review
Market Resource Center Study (Orange)	Final	8/1/96	Pending GPM Review

2.5 SHIPBUILDING MACHINERY AND MARINE TECHNOLOGY EXHIBITION AND CONFERENCE (SMM '96)

The Center participated in the SMM '96 in Hamburg, Germany, October 1 - 5, as part of the U. S. pavilion. The SMM '96 provided an opportunity to publicize the GCRMTC and to establish a dialogue with the operators, contractors, and suppliers of the world's ships. Several thousand visitors attended and valuable contacts were made for possible proposal development.

2.6 GOVERNMENT/INDUSTRY ADVISORY BOARD MEETING

A meeting of the GIAB took place in New Orleans on December 12, 1996, with 18 members attending. The GIAB was briefed on the results of the July 1996 internal concept proposal solicitation and on the status of the Center's operations. The GIAB reviewed the concept proposals and made recommendations which were submitted along with peer review results to the GPM. The GIAB also attended a status briefing of one of the ongoing GCRMTC projects. Future plans regarding upcoming meetings and workshops were also discussed.

3.0 GCRMTC SUBCENTERS

The GCRMTC has initiated three subcenters:

1. Environmental Resource Information Center (ERIC),
2. Simulation-Based Design Center (SBDC),
3. Marketing Resource Center (MRC).

The Environmental Resource Information Center and Simulation-Based Design Center are fully established. The Marketing Resource Center is in the formative stage and is waiting on GPM approval at present.

3.1 ENVIRONMENTAL RESOURCE INFORMATION CENTER

ERIC, established to address environmental issues of the shipbuilding industry, assists with matters pertaining to the planning and implementation of environmental and health related methodologies by providing, with its resident expertise, ready access to available sources of information. ERIC facilitates the collection and distribution of technical and regulatory information within the industry.

3.1.1 ERIC'S ON-GOING AND RAPID RESPONSE ACTIVITIES

3.1.1.1 Document Maintenance and Collection

ERIC continues to add new documents to its library on environmental issues of concern to the shipbuilding and repair industry. ERIC maintains hard copies of all National Shipbuilding Research Program (NSRP) reports dealing with environmental issues, as well as copies of SP-1 Panel progress reports, most memoranda, hand-outs, and other material distributed by mail or at meetings. Also available are current federal and state regulatory information through the Bureau of National Affairs, Inc., "Environmental Reporter," and electronic files. ERIC provides assistance with requests for information from shipyards with copies of reports and other pertinent literature. ERIC's staff can conduct, and will assist others, with their literature searches involving pollution prevention databases.

Information has been collected on sand blasting materials and procedures in response to new Clean Air Act (CAA) PM 10 and 2.5 proposed regulations. Also, information has been acquired on a dust suppressant for use with blasting materials, and a new air filter system capable of reducing air particulate down to 2.5 micron level. New additions to the ERIC library include publications from the Organization for Economic Cooperation and Development (OECD), the World Bank, and the Intra-American Development Bank. A review of the international picture from a financial standpoint is being prepared.

3.1.1.2 NSRP SP-1 and SP-3 Liaison

Four of ERIC's staff attended the SP-1 Panel meeting in Portland, Maine in October. Presentations were made on several ERIC activities, including the identification of environmental resources on the Internet. SP-1 Panel members reiterated their satisfaction with the newsletter produced by ERIC.

The ERIC representative at the SP-3 Panel meeting in Galveston, Texas in October presented a report on the GCRMTC research involving "Pigment for Replacing Chromium."

ERIC and Avondale Industries, Inc. will host the SP-1 and SP-3 meeting in New Orleans during the week of February 3 - 7, 1996, before Mardi Gras. The meetings will be held at UNO's Downtown Center. Rooms have been blocked for the meeting participants at the Hampton Inn Hotel within the UNO Center. An effort is being made to hold one of the ERIC workshops in conjunction with the panel meetings.

3.1.1.3 Environmental Leadership Program

Several local shipyards have joined the Louisiana Environmental Leadership Pollution Prevention Program operating through the University of New Orleans and including ERIC personnel. The program provides an opportunity for industries to publicize their pollution prevention efforts, existing and proposed, and to receive recognition for improving industrial activities. The governor of Louisiana will present awards to companies demonstrating exemplary efforts in pollution prevention.

3.1.1.4 ERIC Toxic Release Inventory Hazard Value Model

ERIC has presented the Comparative Risk Analysis (CRA) software at two conferences and received comments which have been used to revise the program. The software was recently featured at the Environmental Performance Conference. Approximately 50 copies are being distributed as a result of requests.

The Pollution Prevention Committee of the Chemical Manufacturers Association (CMA) also asked that the software be presented at its quarterly national meeting in Washington D.C. In addition, the ERIC staff member who developed the approach has been asked to testify at an EPA hearing on the impact of expanding Toxic Release Inventory (TRI) reporting requirements to include all potentially hazardous materials. An upgraded Version 1.2 of the software was released. The program can be downloaded from the ERIC web page, accessed through the Internet at http://www.uno.edu//~engr/eric.html. Copies of the program disk are also available.

3.1.2 EDUCATIONAL PROGRAMS

3.1.2.1 Workshops

ERIC developed and conducted two half-day workshops on December 12, 1996.

1. The first workshop, titled *Using the World Wide Web for Pollution Prevention at Your Facility,* is designed to help novice computer users. Hands-on instruction and demonstration

of web searches will be conducted to introduce P2 resources that are available online. ERIC made special arrangements to have a number of computers available and connected to the Internet so that attendees were able to practice the techniques covered in the workshop.

2. The second workshop was titled *Comparative Risk Analysis of TRI Data as a Pollution Prevention Management Tool.* ERIC distributed the CRA software (free of charge) to the workshop attendees for use on computers provided at the workshop. The instructor presented the background of the analysis method and showed how it can be used in assessing P2 options in the shipbuilding industry.

An environmental workshop on *Hazardous Solvent Management in the Shipbuilding Industry* is being developed for February 27, 1997, to be presented by Ecolink, Inc. of Stone Mountain, GA. Participants will be provided with practical, down-to-earth, technical and management information for managing solvents in the workplace. Emerging environmental regulations and new alternative solvents will be covered. Special attention will be given to solvent related problems peculiar to the shipbuilding industry.

3.1.2.2 Informational Technical Bulletins

A technical bulletin, *ISO 14000 Standards - International Environmental Standards,* has been developed as an ERIC publication. The fact sheet covers various subsections of these standards, their scope, and the current status. This information will be useful for the shipbuilding industry and will enhance the vision as to how the certification will be useful. Future updates will cover the new developments that occur in these standards. Other draft reports for technical bulletins have been prepared on *Pollution Prevention Opportunities in Coatings and Coating Applications* and *Pollution Prevention Reference for Shipyard Operations.*

3.1.3 VISIBILITY, COMMUNICATIONS, AND INDUSTRY PARTICIPATION

3.1.3.1 Mailing Lists

The number of requests for names to be added to the mailing lists of ERIC and SP-1 newsletters have increased significantly. Thus, the ERIC mailing lists (SP-1 and ERIC) continue to grow.

3.1.3.2 Dust Suppressing Additives

The ERIC staff met with the firm Custom Aggregate to investigate the effectiveness of dust suppressing additives in abrasives. This is particularly important due to the proposed changes in CAA regulations being proposed by EPA for fine particulates in ambient air. ERIC is currently reviewing possible research needs to investigate the effectiveness of dust suppressing additives.

3.1.3.3 Shipyard Association for Environmental Responsibility

During December, the ERIC staff participated in the Shipyard Association for Environmental Responsibility (SAFER) roundtable meeting discussions on the best management practices in

minimizing the release of used abrasives and related pollutants to the atmosphere. SAFER is a consortium of Gulf Coast shipbuilders whose mission is to address impending regulatory legislation that impacts the shipbuilding industry. ERIC's role in assisting the Gulf Coast shipyards in assessing the impact and managing operations producing fine particulates was discussed. ERIC was asked to develop a research project to evaluate the impact of the proposed EPA regulatory changes to control fine particulates in the environment (CAA PM-10 and 2.5 regulations). ERIC is discussing a joint rapid response project in this area with the SP-1 Panel's Environmental Studies and Testing Group.

Technical and professional papers prepared by ERIC staff were submitted for publication to the *Journal of Ship Productions*. Two papers were titled "Risk Analysis of the TRI Emissions from the Shipbuilding, Repair, and Maintenance Industry" and "Environmental Compliance by Japanese Shipyards."

3.1.3.4 ERIC Newsletter

The ERIC Newsletter, Volume 1, Number 2, was mailed out in December. In addition to reporting on recent news notes (EPA guidelines for shipyards, the Gulf Coast shipbuilders SAFER activities, ERIC workshops and seminars, etc.), the newsletter also highlighted articles on "ISO 14000 Standards - What It Means to Shipyards" and "ERIC's Web Notes." ISO 14000 environmental standards are becoming increasingly popular due to the international stature and the endorsement by several governments and major companies. These standards may influence the way business will be conducted in the near future and an ISO certification may become one of the market-driven requirements to be applied by various industries. The article gives an overview of the standards and implication to the shipbuilding industry.

3.1.3.5 ERIC WWW Page

The ERIC WWW page is being maintained to include information on environmental issues, ERIC's and the SP-1 Newsletters, and current regulatory highlights of importance to the shipbuilding and repair industry. Abstracts of GCRMTC environmental project reports are also being included as the reports become available. A status report of current SP-1 projects as well as a list of proposed projects are also available. A counter has been included which will keep track of the number of visits to the home page. Inquiries and requests for assistance and information are also being provided by the ERIC staff. The ERIC WWW page is accessible through Internet at http://www.uno.edu//~engr/eric.html.

The "fax-back" system for delivering documents to users that do not have Internet access is also in place for use as needed. Users can request that documents be faxed back to their location using an activated phone attendant. Document downloading has been made available to the ERIC constituents this quarter.

3.1.4 ERIC'S NSRP ACTIVITIES

3.1.4.1 Meetings

Several of the ERIC staff attended the SP-1 and SP-3 meetings in Portland, Maine, and Galveston, Texas, in October. A brief description of the web page featured in the SP-1 Newsletter was presented at the Portland meeting. Research of interest to SP-3 being conducted at the GCRMTC was reported to the Galveston group.

3.1.4.2 Newsletter

A newsletter identified an important step in NSRP Panel SP-1's strategic plan to improve its visibility and communication with other NSRP Panels, ECB, U.S. shipyards, and other interested groups. ERIC produced and mailed the second SP-1 newsletter in October (Volume 1, Number 2) prior to the SP-1 meeting in Portland, Maine. ERIC has volunteered and assumed responsibility for this SP-1 project. Recent additions by ERIC also include a feature article entitled "The Web Page" as requested by SP-1. The Newsletter is being published several times a year (prior to SP-1 meetings) by ERIC, and contains information on SP-1 Panel projects, regulatory issues, interim reports on selected projects, and other pertinent topics. The SP-3 Panel has also approached ERIC and requested that a newsletter for its group be produced.

3.1.4.3 WWW Environmental Resources

SP-1 wanted to assist its membership in using and identifying environmental resources available on the Internet. Funding was not available to establish this as a fully supported activity by SP-1. With the approval of the SP-1 Panel, ERIC is implementing a program which will address this issue. It initially includes the development of an on-going feature column in the SP-1 Newsletter. The objective is to help less experienced computer users locate useful information on the WWW, in particular, pollution prevention information that is relevant to ship design, construction, and operation. Ultimately, the information developed in preparing these articles will produce a guide document which will be published in the future as a report. The first of the article series has been completed and is in the Fall 1996 NSRP SP-1 Newsletter.

3.1.5 WORK PLAN AND ACTIVITIES PROPOSED FOR NEXT QUARTER

1. Maintain and collect selected reports and documents from NSRP, EPA, and others.

2. Continue development of systems for making ERIC information available to the shipbuilding industry

3. Maintain communications, participate and provide support of NSRP SP-1 and SP-3 Panel activities, and seek opportunities for mutual projects.

4. Host and participate in SP-1 and SP-3 Panel meetings during the New Orleans meeting in February, 1997. Propose and support educational workshops as part of meeting activities.

5. Present workshops and develop other topics for workshops dealing with environmental issues of interest to the industry.

6. Publish several technical bulletins, ERIC *Reports*, on selected projects of interest.

7. Continue maintenance and development of ERIC's Website.

3.2 SIMULATION-BASED DESIGN CENTER

The status of the Simulation-Based Design Center (SBDC) is presented in depth in Section 5.

3.3 MARKETING RESOURCE CENTER

The focus of the Marketing Resource Center (MRC) is to help the maritime industry access relevant data, interpret that information, and use it in planning strategies to increase market share in all areas related to maritime industries. The Center is in the formative stage at present.

An exhaustive study was carried out to understand how others around the world approach marketing. A team from the GCRMTC visited shipyards, research centers, and support industries located around the world. Interviews were conducted with many U. S. based firms to assess how to approach marketing. A report has been submitted to the GPM for approval. These studies formed the basis for preliminary planning to initiate the MRC. Meetings were held with trade associations representing the industry to evaluate strategies and refine the Center's thrust.

Further analysis will be carried out with the GIAB to determine support for the Center and the extent to which it can provide the level and scope of services appropriate to the needs of the maritime industry.

4.0 NEW ORLEANS SITE ACTIVITY REPORT

4.1 INTERNAL RESEARCH PROJECTS

Currently, 15 research projects are in various stages of progress. Quarterly reports of these research projects are attached as appendices to this report and listed below in Table 5. Project AMTC96-053A commenced in late August 1996. Two additional projects (not listed) are pending GPM review. Projects marked with an asterisk were due for completion at the end of this quarter or shortly thereafter. Final reports will be submitted to the GPM for approval.

TABLE 5. INTERNAL RESEARCH PROJECTS

GCRMTC Project No.	Title	Appendix
AMTC95-001A	Inexpensive Non-Toxic Pigment Substitute for Chromium in Primer for Aluminum Substrate	B*
AMTC95-008A	Integrated Environmental Management Plan for Shipbuilding Facilities	C
AMTC95-010A	UNO-Swiftships Development of a Cost Effective Aluminum Catamaran Structure	D*
AMTC95-014A	Applications of Integrated Optical Fiber Sensor Systems in Shipbuilding and Shipboard Monitoring	E*
AMTC95-016A	Research in Shipboard Sensors	F*
AMTC95-018A	Reliability, Availability, and Maintainability (RAM) Database/SHIPNET of Ship Operations Cooperative Program (SOCP)	G*
AMTC95-027A	Software Applications for Shipbuilding Optimization	H*
AMTC95-030A	Improving Technology Transfer in the Shipbuilding Industry	I*
AMTC95-035A	Low Cost Digital Image Photogrammetric Technology in Shipyards	J
AMTC95-036A	Ship Capsizing (An Accurate and Efficient Technique to Predict Ship Roll Damping)	K*
AMTC96-032A	Evaluation of Cr(VI) Exposure Levels in the Shipbuilding Industry	L
AMTC96-033A	Integrating Fire-Tolerant Design and Fabrication of Composite Ship Structures	M
AMTC96-041A	Shock Reduction of Planing Boats	N
AMTC96-053A	Ship Propeller Thrust and Torque Measurement	O
AMTC96-073A	Coanda Circulation Control Maneuvering System	P

4.2 EDUCATION AND TRAINING

Regional workshops were held in New Orleans as discussed in Section 3.1.2

Biweekly seminars are continuing to be held on the research projects in progress. Two projects are presented at each seminar. The primary goals of the seminars are to:

1. Inform the Principal Investigators and their researchers about all ongoing research.

2. Encourage interactions and exchange of ideas among the researchers and their industry collaborators.

3. Inform other faculty members of the opportunities available for research projects.

5.0 ORANGE SITE ACTIVITY REPORT

The Orange Site and its Simulation Based Design Center (SBDC) initiated several activities during the reporting period. These included:

1. Internal planning,
2. Personnel actions,
3. Review and modifications to subcontract projects,
4. Continuation of activities within existing subcontracts,
5. Software acquisition,
6. Proposal preparation for specific maritime partners.

5.1 PLANNING

Planning is an ongoing process within the Orange Site. In October, meetings were held to redefine the Site's vision, purpose, mission, and goals. Attention was directed towards integrating simulation based design responsibilities within the overall scope of activities of the Gulf Coast Region Maritime Technology Center. By December, the purpose had been re-written; goals are being refined and will be finalized during the next reporting period. This effort will incorporate the needs of industry (the customer base) as well as needs of the sponsoring agencies.

5.2 PERSONNEL

Throughout the quarter, the staff interviewed engineers and support staff in response to existing vacancies. The Site staff and the GCRMTC interviewed eight candidates for engineering positions. Of the eight candidates interviewed, three were offered employment. All new employees possess a Ph.D. in mechanical engineering and each has significant experience with simulation, modeling, and virtual reality technologies.

The Orange Site staff is re-evaluating the two remaining vacancies within engineering and anticipates filling one position with a naval architect. Expertise in naval architecture is currently provided through the School of Naval Architecture and Marine Engineering of the College of Engineering at the University of New Orleans.

The Site has identified and hired a replacement for the Network and MIS Manager. The individual holds a graduate degree in computer information systems and computer engineering.

The staff assistant to the director has been on staff throughout the reporting period. This position has expanded ensuring closer coordination among various university departments.

Throughout the reporting period the Orange Site has employed "intermittent" employees responding to specific and short-term needs. This includes graduate students who have assisted with computer

programming and a graphics expert who is assigned to one of the subcontracts, namely, Mobile Offshore Base Systems (MOBS). Five additional intermittent employees have been identified and retained for the upcoming reporting period.

5.3 PROPOSED SUBCONTRACT PROJECTS

The SBDC is negotiating subcontracts for specific activities consistent with the Center's expertise and technology capabilities. These include the following projects:

1. A proposed subcontract with Avondale Industries, Inc. for the RORO MARITECH program is in the pre-award phase (see Appendix V). Due to barriers Avondale has experienced with the contracting agency, MARAD, the subcontract with the GCRMTC has yet to be finalized. However, Avondale has assured in writing that the SBDC will be reimbursed for pre-award costs. Avondale has notified the GCRMTC that the subcontract will be issued in the early part of the upcoming quarter. Consequently, the full scope of the center's participation in this project has been delayed until funds are released by MARITECH. Current project expenditures are continuing under the pre-award cost phase for all participants in this project. During the reporting period, the SBDC hired one full-time naval architect who was assigned this project and is on site at Avondale in New Orleans, Louisiana. Although the specific delineations of work requirements are awaiting development of the subcontract, the staff has been engaged in training, planning, and initial design work. Monthly progress reports are received delineating the nature and progress made on meeting the project milestones.

2. A subcontract is expected to be executed with McDonnell Douglas for the evaluation and determination of applications of the Smart Product Model (developed by Newport News Shipbuilding) within the aerospace industry. This project will start next quarter.

5.4 CONTINUATION OF ACTIVITIES WITHIN EXISTING SUBCONTRACTS

The Orange Site has one ongoing subcontract. The SBDC continued implementing its statement of work responsibilities within its subcontract with McDermott Shipbuilding for the Mobile Offshore Base (MOB) project (see Appendix U). To date, Tasks I and II activities are complete, training has been conducted, and modifications to models have been developed.

5.5 SOFTWARE ACQUISITION

The SBDC acquired additional software which enhances the core functional capabilities of the Center and broadens the range of activities which can be undertaken within the Center. These programs include WAMIT Wave-Body Interaction Program and Coryphaeus Maritime Module Visual Simulation software.

Additionally, the Center has contracted with Dynamic Animation Systems to develop an interface between the Coryphaeus Maritime Module and the ADAMS mechanical simulation software programs.

The interface allows for the simultaneous analysis in real time of ship motions in different sea states and is required for completion of the MOB project.

5.6 PROPOSAL PREPARATION FOR MARITIME PARTNERS

The SBDC has been working with Avondale on several collateral projects related to RORO and the LPD-17. Primary emphasis has been on internal Integrated Process and Product Development (IPPD) training, team building, planning, and related activities. The SBDC has submitted a proposal to Avondale for two phases of work. The first is a basic, generic proposal which provides generalized orientations to IPPD and teambuilding. This effort would be provided by Center staff and become the basis of a model which can be replicated at other shipyards. The second proposal includes a comprehensive effort to provide in-service training for all Avondale workers related to IPPD and how that would integrate within the LPD-17 acquisition. This program is designed to respond to specific Avondale needs and would be on a subcontract basis. The Center anticipates a response from Avondale within the next reporting period.

The SBDC has submitted proposals to the American Bureau of Shipbuilding and is working to finalize a joint effort. Additional meetings are scheduled during the next quarter.

The Center staff has been working with McDonnell Douglas to develop a concept proposal for the design (in a collaborative environment) for other acquisitions. This project requires considerable planning and coordination and will be updated in subsequent quarterly reports.

In October, two representatives from the Korean Research Institute of Ships and Ocean Engineering (KRISO) located in Taejon, Korea, visited the Orange Site to explore partnering with GCRMTC in the areas of electronic commerce and other mutually beneficial technology related initiatives. One staff member has been invited to Korea to present ideas for consideration and to engage in further discussions.

6.0 GCRMTC ACTIVITIES PLANNED FOR NEXT QUARTER

In addition to future work described in previous sections and in the individual projects in the appendixes, work is planned over the next quarter in the following areas.

1. Subcontracts will be awarded upon GPM approval of proposals currently under his review.

2. Work will continue under the four subcontracts awarded in June 1996. Quarterly meetings will be held between the subcontractors and the GCRMTC representatives monitoring the subcontracts.

3. A solicitation for concept proposals (internal and external) will be conducted.

4. The Marketing Resource Center Feasibility Study will be released on approval of the GPM.

5. Interim and/or final research reports will be printed and published as they are approved by the GPM.

6. The Center will increase its efforts to provide workshops for the maritime industries.

7. Work will commence on several NSRP subcontracts that were awarded this quarter.

8. RFPs will be issued based on the results of the May 1996 GIAB meeting and subject to the availability of funds.

7.0 SUMMARY

The GCRMTC objectives and milestones as defined by the Cooperative Agreement continue to be met in a timely fashion. The achievements of the two Sites and the Center during the fourth quarter of 1996 were as follows:

1. The Center transmitted recommendations to the GPM for proposals submitted in response to the April 1996 RFPs. See Section 2.1 for the status of proposals.

2. Research projects and subcontracts are ongoing at both Sites and the status of 17 projects and 4 subcontracts are appended. See Section 2.2 for a listing of the subcontracted research.

3. The Center issued agreements to fund five NSRP research projects at a cost of $1.5 million based on commitments to the Executive Control Board of the NSRP and the NSRP panels some time ago. Two other agreements are pending additional review. See Section 2.3 for details.

4. A summary of the status of all the interim and final reports is shown in Section 2.4.

5. ERIC and SBDC are fully operational and actively addressing their respective missions. Their activities are delineated in Sections 3.1 and 3.2, respectively. The Marketing Resource Center is in the formative stage at present, as described in Section 3.2.

6. The GCRMTC set up and operated a booth at the SMM '96 (Exhibition and Conference) in Hamburg, Germany October 1 - 5, 1996.

7. A master schedule for all GCRMTC activities has been included as Appendix A for reference.

8.0 RECOMMENDATIONS

Based on a review of the last quarter's activities of the Center, the New Orleans Site, and the Orange Site, along with feedback from the Program Manager and staff, the following actions are recommended:

1. Upon approval from the GPM of the May 1996 GIAB Meeting recommendations, initiate internal proposals and issue appropriate RFPs for external proposals.

2. Continue arrangements for the Center and its two Sites to set up and operate a booth in the U.S. pavilion at the SMM exhibition and conference in New York on September 9 - 11, 1997.

3. Recognizing the uncertainty in the amount of FY96 funding, prepare contingency operational plans for the Center.

4. Finalize personal selection for the Marketing Resource Center and solicit clients and partnerships.

5. Plan and hold the semi-annual GIAB meeting at the University of New Orleans.

6. Continue planning for a workshop to re-visit the GCRMTC focus areas.

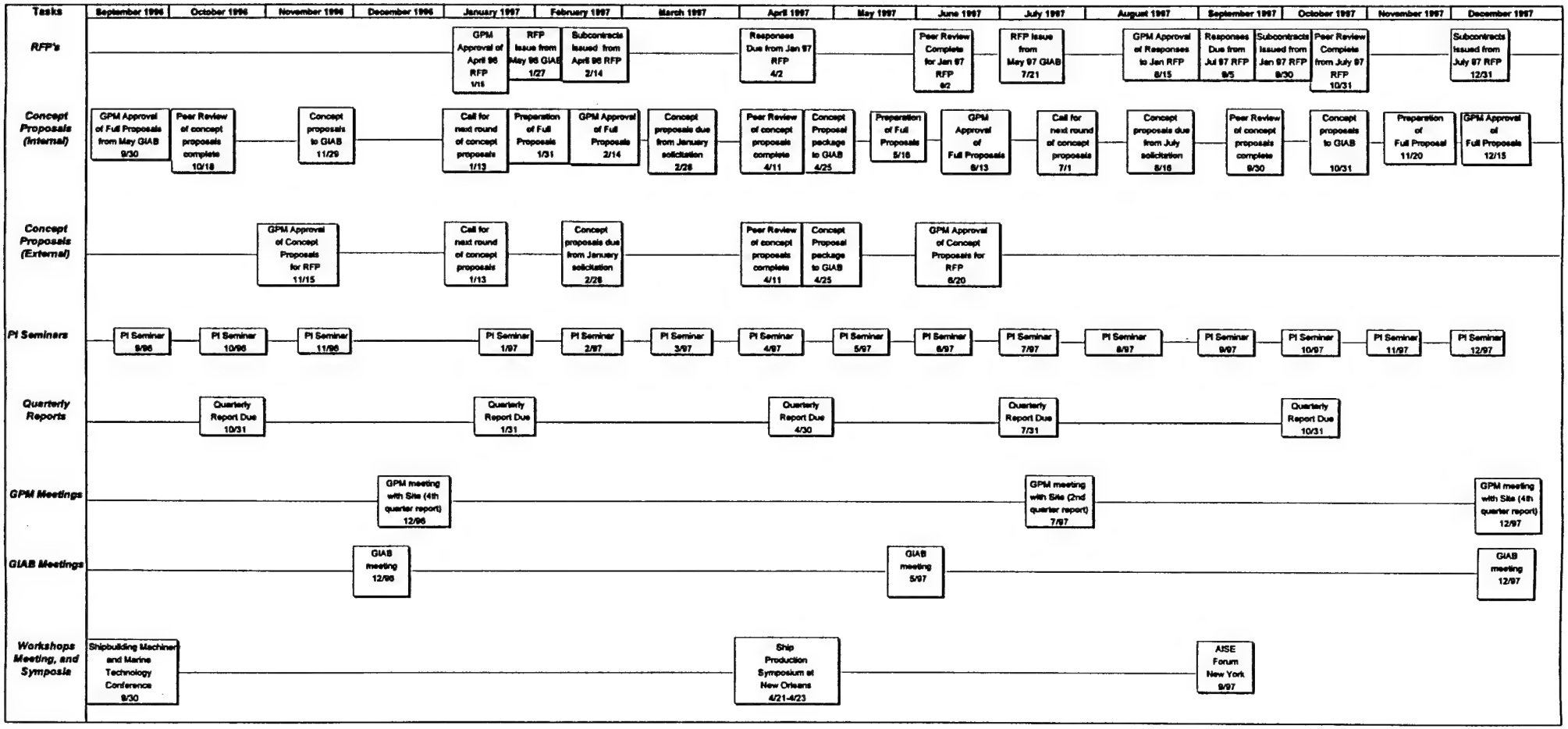
APPENDIX A

GULF COAST REGION MARITIME TECHNOLOGY CENTER

MASTER SCHEDULE

University of New Orleans
New Orleans, LA 70148

Gulf Coast Region Maritime Technology Center and New Orleans Site Master Schedule



University of New Orleans GCRMTC/Orange Site Program Master Schedule

Name	Planned Start	Planned Finish	Actual Start	Actual/ Projected Finish	% Done
Administrative/Program Transition Issues	5/1/96	8/31/96	5/1/96	8/31/96	100
Core Staffing	7/19/96	12/31/96	8/12/96	12/31/96	100
Project Staffing	8/12/96	1/31/97	8/12/96	1/13/97	80
Strategic Planning-External	7/1/96	9/30/96	7/1/96	2/28/97	50
Strategic Planning-Internal	9/1/96	12/31/96	9/3/96	1/15/97	90
Staff Realignment	9/1/96	12/31/96	9/3/96	3/31/97	40
External Project Development & Funding	3/1/96	9/30/97	3/1/96	9/30/97	40
Equipment Upgrade Evaluation & Procurement	5/1/96	2/28/97	5/14/96	2/28/97	70
Software Upgrade Evaluation & Procurement	5/1/96	3/31/97	6/3/96	3/31/97	85
Mobile Offshore Base Project	5/15/96	4/1/97	9/5/96	4/1/97	40
Avondale Roll-On/Roll-Off (ARRO) Project	7/15/96	7/15/98	7/15/96	7/15/98	10
SMART Product Model Project	9/1/96	12/31/97	9/1/96	12/31/97	10
Virtual Shipyard Project	9/1/96	12/31/97	9/1/96	12/31/97	2

APPENDIX B

INEXPENSIVE NON-TOXIC PIGMENT SUBSTITUTE FOR CHROMIUM IN PRIMER FOR ALUMINUM SUBSTRATE

PHASE II

GCRMTC PROJECT NO. AMTC95-001A

Principal Investigator:

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Department of Civil and Environmental Engineering

Additional Researchers:

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Department of Civil and Environmental Engineering

Nikhil K. Sarkar, Ph.D.
Department of Biomaterials - LSU Medical Center

Research Assistants:

Li Li
Department of Civil and Environmental Engineering

Raisa Moiseyeva
Department of Biomaterials - LSU Medical Center

University of New Orleans
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B.1 PROJECT SYNOPSIS

Lithium carbonate in solution has been shown to protect certain metals, particularly aluminum, from corrosion by reacting at the surface, a phenomena confirmed by the Secondary Ion Mass Spectrometer (SIMS). Sodium carbonate and potassium carbonate reactions produce a soluble product and no alkali is detected on the surface by SIMS. Because of their high solubility and reactivity, most "alkaline metal" compounds are not suitable for corrosion protection. Metallic aluminum normally provides its own corrosion protection because of its tendency to form an aluminum oxide insulator on the surface, but the matrix of hydrated aluminum oxide is penetrated by chemicals such as NaCl, acid and bases.

Engineers and scientists observed that certain aluminum-lithium alloys demonstrated some diffusion of lithium to the surface of the alloy. The lithium ion is so small that it penetrates the large interstitial spaces of the aluminum oxide layer. The aluminum-lithium alloys are stable in chemical composition at ordinary temperatures, but a lithium-rich surface can be easily produced in the alloy by briefly heating to facilitate the migration. It appears that certain lithium alloys or compounds can be incorporated into a paint vehicle or otherwise deposited on the surface of aluminum alloys to provide corrosion protection when exposed to salt water, humidity, and other corrosive environments.

Tests using an EG&G Potentiostat verified that many lithium compounds will passivate aluminum. Furthermore, the lithium-rich pigment particles provide a reactive material which enhances the bond. SEM photos included in this report show the bond line of an aluminum pigment with the surface enriched with lithium, a resin, and the aluminum substrate. The bond actually is such that the coating and the metal intersperse so that they become a new entity and the "bond line" disappears.

Various pigment treatments and various substrates, including different aluminum alloys as well as steel, were coated and sent to an independent testing laboratory for ASTM 117 salt spray testing. Test results are forthcoming, and it is anticipated that most of these will pass based on the laboratory tests.

The results, which will be reported in the final report, will close out the project and fulfill the objective and scope of the project.

Lithium compounds appear to offer a viable alternative to chromium using a new concept of corrosion inhibition, with a minimum of environmental impact. This research involves the creation of new primer inhibitors based on aluminum-lithium compounds and the development of a non-polluting paint vehicle which can be used as a primer.

B.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED	$163,899
FUNDS EXPENDED	$163,899

B.3 ACCOMPLISHMENTS DURING CURRENT QUARTER

TASK I: OBTAIN VEHICLES

The pigments are incorporated into various resins of the paint industry. These vehicles must be compatible and non-polluting.

Euro Navy USA has provided the following vehicles for our formulations; others were purchased.

1. Three types of epoxy based paint vehicle,
2. One styrene acrylic based latex paint vehicle,
3. One acrylic/vinyl thermoplastic paint vehicle,
4. Two silicate vehicles.

These vehicles are being used or considered for use by the Navy. The silicate vehicles look especially promising and will be further tested.

TASK II: TEST VEHICLES/PIGMENT COMBINATIONS

Carboline's commercial product "Carbozinc" was investigated and the group of reformulated vehicles/pigment were tested for comparison (see Attachment 1).

TASK III: LABORATORY TESTS OF SELECTED PAINTS

Laboratory tests of selected paints were performed during this quarter. The fundamental piece of equipment used in the tests was the Model 352/252 Soft Corr™II Corrosion Measurement and Analysis software manufactured by EG&G Instrument Division of Princeton Applied Research. The selected pigments were tested in combination with vehicles to make paints. Coated panels were tested in humidity and salt.

TASK IV: PHYSICAL TESTS OF PAINT

The lithium silicate vehicle and the aluminum lithium pigment were compatible. The panels were bent over a mandrel. The adhesion and the film integrity were acceptable but needed improvement.

TASK V: FIELD TEST OF PAINT

Thirty-nine panels were being tested to ASTM 117 salt spray at KTA Tater, Inc. in Pittsburgh, PA.

TASK VI: MANUFACTURING METHODS

This task was completed. The paint selection was made. The lithium silicate is water based and can be stirred into solutions without high-speed dispensers.

TASK VII: REFORMULATE

The reformulation was done with lithium compounds, barium sulfate, mica, and other chemicals. The intention was to obtain good adhesion and a homogeneous film. Wetting agents were not added.

TASK VIII:CONTINUING PIGMENTS TEST

The pigment variations are tested as ideas are generated. The effectiveness of a multifunctional polymer in forming adherent protective coatings on Al-alloy surfaces was also studied during this quarter. SEM photographs were taken to appraise performance.

TASK IX: ARGON OVEN

The oven was installed and used to convert aluminum-lithium alloy into an aluminum particle "plated," so to speak, with lithium. The pigment particles can be partially or completely "plated." This permits reactions and galvanic action.

TASK X: SURFACE ANALYSES

Surface analyses have been accomplished on reformulated paints and on multifunctional polymer treatment to aluminum. Some of the scanning electron microscopy (SEM) photos are enclosed as Attachment 2. The continuity of deposits on the surface was investigated. Bond lines were evaluated.

B.4 PROPOSED ACTIVITIES NEXT QUARTER

This project has been completed. The final report will be submitted in January 1997.

B.5 COLLABORATIVE EFFORTS

	CURRENT QTR.	YTD
$ VALUE OF SERVICES FROM INDUSTRY:		
In-Kind Services (Experimental vehicles from Euro Navy):		$5,000
Actual Funds:		None
$ Value of Equipment from LSU:		$86,190
$ VALUE OF SERVICES FROM GOVERNMENT:		
In-Kind Services:		None
Actual Funds:		None

NUMBER OF SIGNIFICANT CONTACTS:	CURRENT QTR.	YTD
Industry:	6	17
Academic:	2	8
Government:	2	7

COMMENTS:

1. Three patents have been proposed to LSU legal representatives, as listed below:

    a. An environmentally acceptable corrosion resistant coating.
    b. Nanostructural corrosion inhibitors.
    c. An inhibitor for aluminum containers (such as automobile radiators).

2. Arrangements have been made with Walt Fortenbery to coat a part of a vessel (tentative) at Newport News.

3. Two papers have been written. One was published and another is scheduled to be presented to NSRP and SNAME in New Orleans on April 21, 1997.

ATTACHMENT 1 TO APPENDIX B

VEHICLES/PIGMENT REFORMULATION, TEST, AND ANALYSES

A silicate was tested which will make a paint similar to Ameron's "Dimetcoat" or Carboline's "Carbozinc," which use sodium silicate or partially hydrolyzed ethyl silicate and zinc dust. A special silicate and an aluminum lithium dust are being investigated. The zinc filled products are for steel, but the products being investigated will be for aluminum. The standard electrode potential for zinc is -0.76 and for iron is -0.44; lithium is -3.045, while aluminum is -1.67 (volts as compared to hydrogen). Thus, zinc protects iron (being more electronegative) and lithium should protect aluminum.

TEST MATRIX

GROUP	SET	PANEL ID	DESCRIPTION
Group A	Set 1	A6 #13, A6 #14, A6 #15	A3, A5, A6, and S represent aluminum alloys 3001, 5052, 6061, and steel. This group is for testing the effect of same pigment on different alloys. Formula of pigment: Lithsil-6 = 100 Al-Li powder (350°C heated in argon oven 15 min.) = 57.5% MICA = 7.5% Li_2MoO_4 = 0.5% $Na_2B_4O_710H_2O$ = 0.4% (of total weight) Drying condition: 70±5°C, 5±1 hrs.
	Set 2	A5 #26, A5 #27, A5 #28	
	Set 3	A3 #3, A3 #7, A3 #2	
	Set 4	S1, S2, S3, S4	
Group B	Set 5	A6 #17, A6 #19, A6 #21	This group is for testing the effect of different curing conditions (with different temperature treatment and air dry or self-curing). Set 5 was made by using the same formula as above, except using 180°C, 0.5 hr. heat treatment after applying the pigment.
	Set 6	A6 #11, A6 #3, A6 #4	Set 6 was made by using the same formula as above and dried in air (room temperature is about 20°C) after applying the pigment.
	Set 1	A6 #13, A6 #14, A6 #15	Set 1 is the same as above in Group A (70±5°C, 5±1 hrs.).

Group C	Set 7	A6 #24, A6 #25, A6 #26	This group is designed for comparing the preheating treatment of the Al-Li powder with different period of time. Set 7 was made by the same formula as Group A, but the Al-Li powder was not heated.
	Set 8	A6 #33, A6 #34, A6 #35	Set 8 was made by the same formula as Group A, but the Al-Li powder was heated in argon oven for 0.5 hr. at 350°C.
	Set 1	A6 #13, A6 #14, A6 #15	Set 1 is the same as above in Group A (with 15 min. heating Al-Li powder in argon oven).
Group D	Set 9	A6 #30, A6 #31, A6 #32	This group was designed for comparing the effect of Li_2MoO_4 in the pigment. Set 9 was made by the same formula as Group A, but without adding Li_2MoO_4.
	Set 1	A6 #13, A6 #14, A6 #15	Set 1 is the same as above in Group A (with 0.5% Li_2MoO_4).
Group E	Set 10	A6 #20, A6 #22	This group was designed for comparing the process of acid pre-treatment on the surface and the process without acid treatment before applying the pigment. Set 10 panels were dipped in the 15% HNO_3 for a few seconds and after dry applied the pigment as Group A.
	Set 1	A6 #13, A6 #14, A6 #15	Set 1 is the same as above in Group A (without acid pre-treatment).
Group F	Set 11	A6 #27, A6 #28, A6 #29	This group was designed for comparing the effect of pigment with curing agent sodium borate and without curing agent. Set 11 panels were applied with the pigment without adding curing agent sodium borate and the rest of the formula is the same as in Group A.
	Set 1	A6 #13, A6 #14, A6 #15	Set 1 is the same as above in Group A (with 0.4% sodium borate).

Others (all panels are aluminum alloy 5052)		#18, #19, #20, #21, #22, #25	#18 (with Carboline top paint on); #19 and #20 with pigment formula below: Lithsil-6 = 100% Al-Li powder with 350°C heating in argon oven for 1 hr. = 53.66% MICA = 14% Li_2MoO_4 = 0.5% #21 (with Carboline top paint on) and #22 with the formula below: Lithsil-6 = 100% Al-Li powder (without heating) = 49.06% MICA = 19.3% Li_2MoO_4 = 0.5% #25 used formula as below: Lithsil-6 = 100% Al-Li powder with 350°C heating in argon oven for 1 hr. = 47% Zn powder = 174% MICA = 8.5% Li_2MoO_4 = 0.5%

Notes:

1. The panel's ID is on the top of the panel. Most panels have both letter and number, for example A6 #17, but some only have # on the right-hand corner, for example #18, #19. Both upper corners should be checked. The panels should be scraped as required.

2. All panels were hand polished by using #150 grit sand paper before applying the pigment.

ATTACHMENT 2 TO APPENDIX B

SCANNING ELECTRON MICROSCOPY (SEM) PHOTOGRAPHS ON SURFACE ANALYSES SHOWING BOND LINE

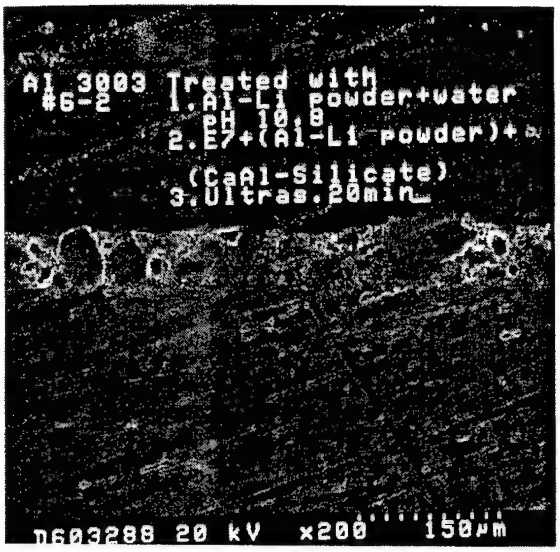


Figure 1. SEM Photograph of Surface Analysis X200

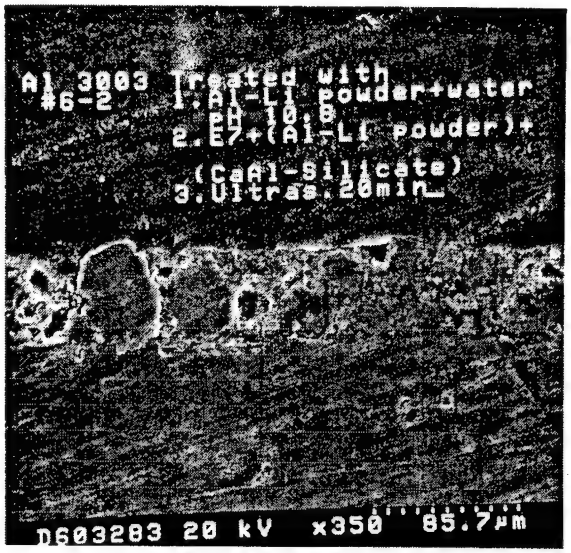


Figure 2. SEM Photograph of Surface Analysis X350

Figure 3. SEM Photograph of Surface Analysis X600

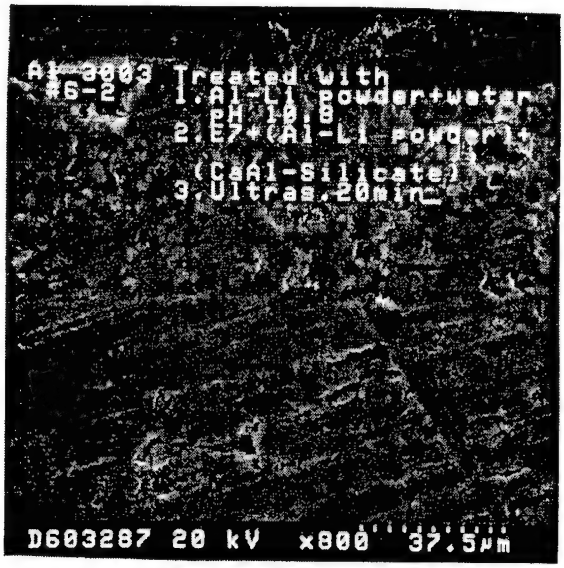
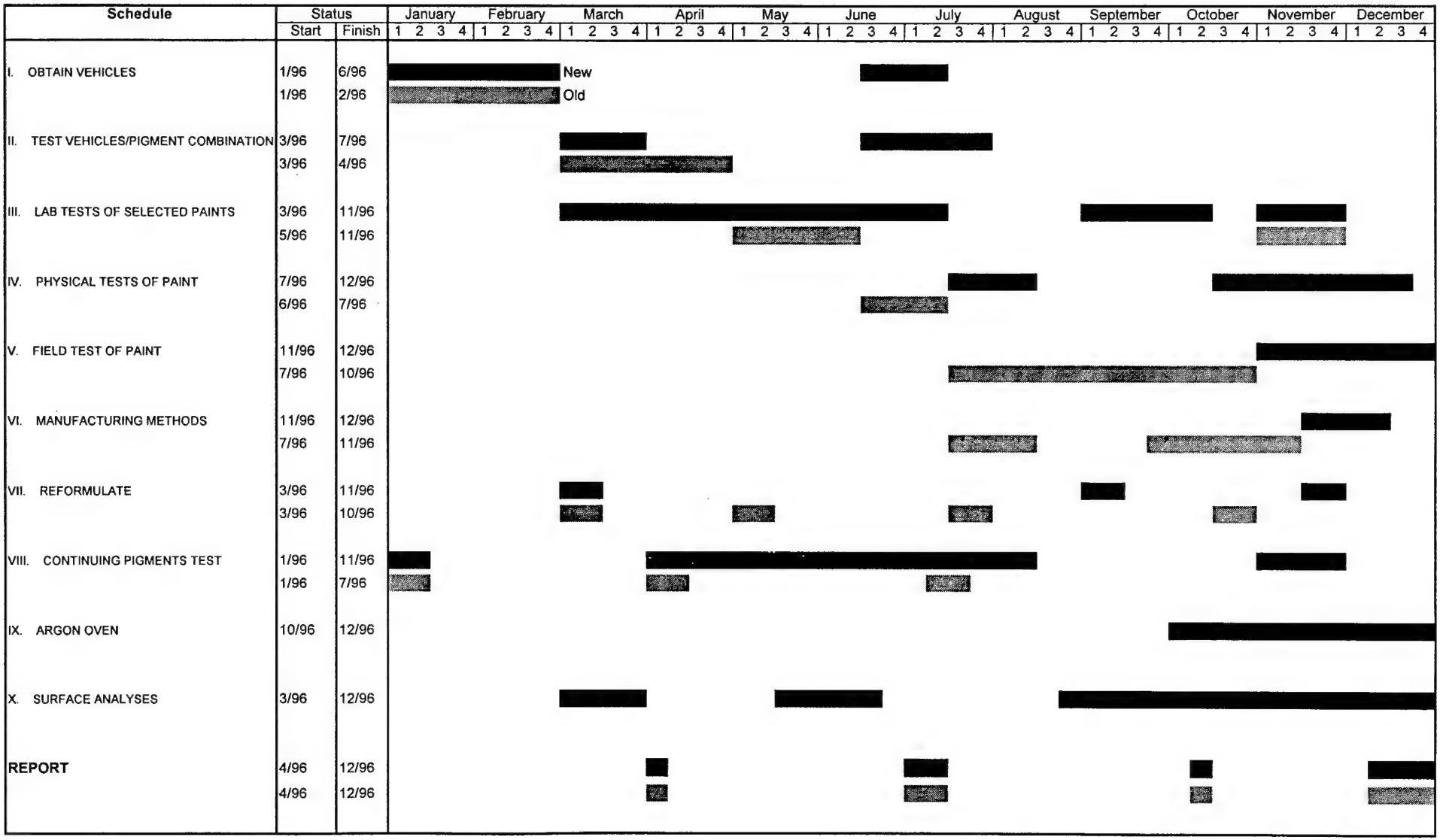


Figure 4. SEM Photograph of Surface Analysis X800

Inexpensive Non-Toxic Pigment Substitute for Chromium in Primer for Aluminum Substrate



Note: Readjustment in the time lines were caused by delays in funding.

APPENDIX C

INTEGRATED ENVIRONMENTAL MANAGEMENT PLAN FOR SHIPBUILDING FACILITIES

PHASE II

GCRMTC PROJECT NO. AMTC95-008A

Principal Investigator:

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Additional Investigators:

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Department of Chemistry

Shing Lee, Ph.D. and **Xiao-Rong Li, Ph.D.**
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C.1 PROJECT SYNOPSIS

This project develops an integrated environmental management plan for shipbuilding facilities that includes source reduction (waste minimization at the source), recycling, treatment, and disposal. To achieve the research objectives, Avondale Shipyards will be closely studied with data collection from other sources on activities that are not common to Avondale. The project duration is three years with interim reports at the end of each year. The final product will contain two reports: a specific Environmental Management Plan (EMP) to serve Avondale and a generic EMP to serve the shipbuilding industry in general.

The main components of the study are process review, identification of pollution sources, quantification of pollutants (in solids, water, and air streams), impact evaluation, review recycling/treatment alternatives, study disposal alternatives, and regulatory compliance. During the first year, activities were completed concerning sources of pollution and emission quantification. The second year activities include characterization of waste streams, review of current pollution management practices, review of source reduction methods, and development of management systems for air, wastewater, and solid wastes.

C.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED	$219,350
FUNDS REMAINING	$132,000

NOTE: Second year activities of this project span from July 1996 to June 1997, not from January to December.

C.3 ACCOMPLISHMENTS DURING CURRENT QUARTER

The status of original tasks scheduled for the second year are discussed below.

TASK 4: CHARACTERIZATION OF WASTE STREAMS

1. Air Quality

Air samples were analyzed using the open path Fourier Transform Infra-Red (FTIR) method at Avondale Shipyards to determine if the method can effectively measure specific volatile organic compounds (VOC) in the ambient air that are of interest to shipyards. Specific compounds being studied are the following:

- Xylenes
- Methyl benzene
- Chloroform
- Methylene chloride
- 1,2,4-trimethylbenzene

- Trichlorofluoromethane
- Toluene
- Acetone
- Ethyl benzene
- 1,2-dichloro-1,1,2,2-tetraflouroethane
- 1,1,2-trichloro-1,2,2-trifluoroethane
- Carbon tetrachloride
- 1,2-Dibromoethane
- 1,2,4-Trichlorobenzene

Analysis of ambient air samples collected using Summa canisters were analyzed for 43 organic compounds using Environmental Protection Agency (EPA) Method TO14, which was evaluated for application in a shipyard environment.

The measurement method for ambient PM_{10} and $PM_{2.5}$ monitoring was evaluated using portable equipment from Monitoring Instruments for the Environment, Inc. (MIE).

The EPA's new proposed regulations on fine particulates and ozone are being followed closely to determine how they affect shipyard operations, monitoring, and compliance. On November 27, 1996, the EPA proposed new standards for ambient $PM_{2.5}$ and changes in ambient ozone standards. The public, industry, and scientists were informed through a live telecast organized by the EPA on December 9, 1996, at selected locations nationwide.

Based on the initial assessment, these new standards may severely restrict the way shipyard operations are carried out. Particularly, abrasive blasting and welding operations may be affected by the new proposed regulations on fine particulates in ambient air. Also, painting operations and diesel engine emissions may have some secondary impact due to the proposed regulations on ambient ozone levels. Although ozone is not a primary pollutant emitted by shipyard operations, precursors of ozone formation, such as selective VOC's (mainly hydrocarbons) and oxides of nitrogen, are emitted because of shipyard operations.

2. *Wastewater*

Discussions were held with Avondale regarding the sample collection methodology and the coordination required. Wastewater samples were collected with assistance from their gas-free plant personnel.

Samples are being analyzed by a laboratory in New Orleans for wastewater parameters, such as biochemical oxygen demand (BOD), chemical oxygen demand (COD), oil and grease, total suspended solids (TSS), and total organic carbon (TOC), etc.

TASK 4A: FEASIBILITY - AIR AND WATER QUALITY MONITORS

An extensive literature search on fiber optic chemical sensing was conducted. Based on the literature, remote spectroscopic techniques appear to be the most attractive, as they can instantaneously detect intrinsic physical properties. Due to the use of advanced solid state fiber optic technology, portable spectrophotometers have become rugged and inexpensive. However, different approaches need to be

examined to check the suitability of accommodating the large number and wide dynamic concentration ranges of shipyard pollutants.

A spectrophotometer was purchased recently for testing purposes. The detector, amplifiers, and a number of labview programs were devised and developed. The spectrophotometer is now fully operational.

TASK 5: REVIEW OF EXISTING WASTE MANAGEMENT TECHNIQUES

A detailed, 10-page questionnaire was designed to obtain information on shipyard processes, materials used, waste quantities used, costs incurred, regulatory requirements, and the current waste handling procedures.

The questionnaire was sent to several commercial and Naval shipyards in the country. Important shipyards contacted, along with the respective environmental manager, are listed below:

Avondale Shipyards, Inc., Avondale, LA	- Mr. Steve Lacoste
Newport News Shipbuilding, Newport, VA	- Mr. Frank Thorn
National Steel and Shipbuilding Company, San Diego, CA	- Mr. Mike Chee
Alabama Shipyard Inc., Mobile, AL	- Mr. Juliam Bingham
Atlantic Dry Dock Corporation, Jacksonville, FL	- Mr. Timothy J. Welsh
Atlantic Marine, Inc., Mobile, AL	- Mr. Juliam Bingham
Bath Iron Works, Portland, ME	- Ms. Jennifer C. Parker
General Dynamics - Electric Boat Division	- Ms. Donna Frechette
Norfolk Shipbuilding Company, Norfolk, VA	- Mr. Tom Beecham
Ingalls Shipbuilding, Inc., Pascagoula, MS	- Mr. Kay Freeman
South West Marine, Inc., San Diego, CA	- Mr. Armando De Quesada
Trinity Marine Group, Gulfport, MS	- Mr. Pat Kileen
Peterson Builders, Inc., Sturgeon Bay, WI	- Mr. Ellsworth L. Peterson
Puget Sound Naval Shipyards, Bremerton, WA	- Mr. Robert Benze

Since only one response has been received so far, shipyards are being contacted to obtain this information. Selected shipyards will be visited within available budget limits.

TASK 6: WASTE MINIMIZATION THROUGH SOURCE REDUCTION

Source reduction methods identified in EPA documents are being reviewed that deal with cleaner technologies which ultimately prevent waste generation. Documents collected and being reviewed are as follows:

- Cleaner Technologies for Organic Coatings Removal
- Cleaner Technologies for Organic Coatings Replacements
- Cleaner Technologies for Metal Finishing
- Cleaner Technologies for Cleaning and Degreasing Process Changes
- Cleaner Technologies for Chlorinated Solvents for Cleaning and Degreasing

OTHER PROJECT-RELATED ACTIVITIES COMPLETED DURING CURRENT QUARTER

1. An abstract, titled "Measurement of Ambient VOCs in Shipyard Environment Using an Open-Path FTIR Method," was submitted for presentation at the 90th Annual Conference of the Air & Waste Management Association (A&WMA) to be held in Toronto, Canada, in June 1997. The abstract was accepted for presentation at this conference.

2. ISO 14000 - International Standards for Environmental Management Systems and issues concerning the development process of these standards are being followed closely to understand the future implications on shipyards.

3. Attended the National Shipbuilding Research Program (NSRP) SP1 Conference in Portland, Maine, to understand the main environmental issues concerning shipyards. Participated in NSRP's meeting to brainstorm and develop project ideas which will address environmental concerns at shipyards.

4. Presented the progress made on this project, assistance required from various shipyards and the questionnaire sent to the shipyards. The format of the questionnaire and instructions for completing various sections were discussed.

5. A new proposal, titled "An Expert System for Shipyard Environmental Management," was developed and presented at the NSRP-SP1 meeting in Portland, Maine. This proposed expert system facilitates effective implementation of the EMP being developed for shipyards.

6. A small demo of the proposed expert system for shipyard environmental management was built to explain to shipyards and other interest groups the effectiveness and the functionality of the expert system proposed.

7. Bath Iron Works in Maine was visited to become familiar with their shipyard processes, environmental concerns, and waste management practices.

C.5 PROPOSED ACTIVITIES NEXT PERIOD

1. Coordinate with Drs. Shing Lee and Rong Li concerning the feasibility of developing air and water quality analyzers. Preliminary testing of shipyard pollutants is planned to consolidate the approach on shipyard pollution monitoring.

2. As a follow up, shipyards will be contacted to obtain current waste management practices. Within available budget limits, possible visits will be made to selected shipyards.

3. Continue to review and evaluate the cleaner technologies available for other shipyard processes to minimize waste generation through source reduction.

4. Initiate multimedia emission management, viz., management of solid waste, wastewater, and air quality. Review and refer to ISO 14000, International Environmental Management System guidelines, for possible adaptation into the proposed EMP for shipyards.

C.6 COLLABORATIVE EFFORTS

	CURRENT QTR.	YTD
$ VALUE OF SERVICES FROM INDUSTRY:		
In-Kind Services:	3,750[a]	7,500
Actual Funds:		
$ VALUE OF SERVICES FROM GOVERNMENT:		
In-Kind Services:	0	11,000
Actual Funds:		
NUMBER OF SIGNIFICANT CONTACTS:		
Industry:	4[b]	4
Academic:	0	0
Government:	1[c]	2

COMMENTS:

[a] Includes the cost of Avondale staff time during field visits, providing information, assisting during field measurements, etc. This amounted to one quarter man-month time of Avondale personnel.

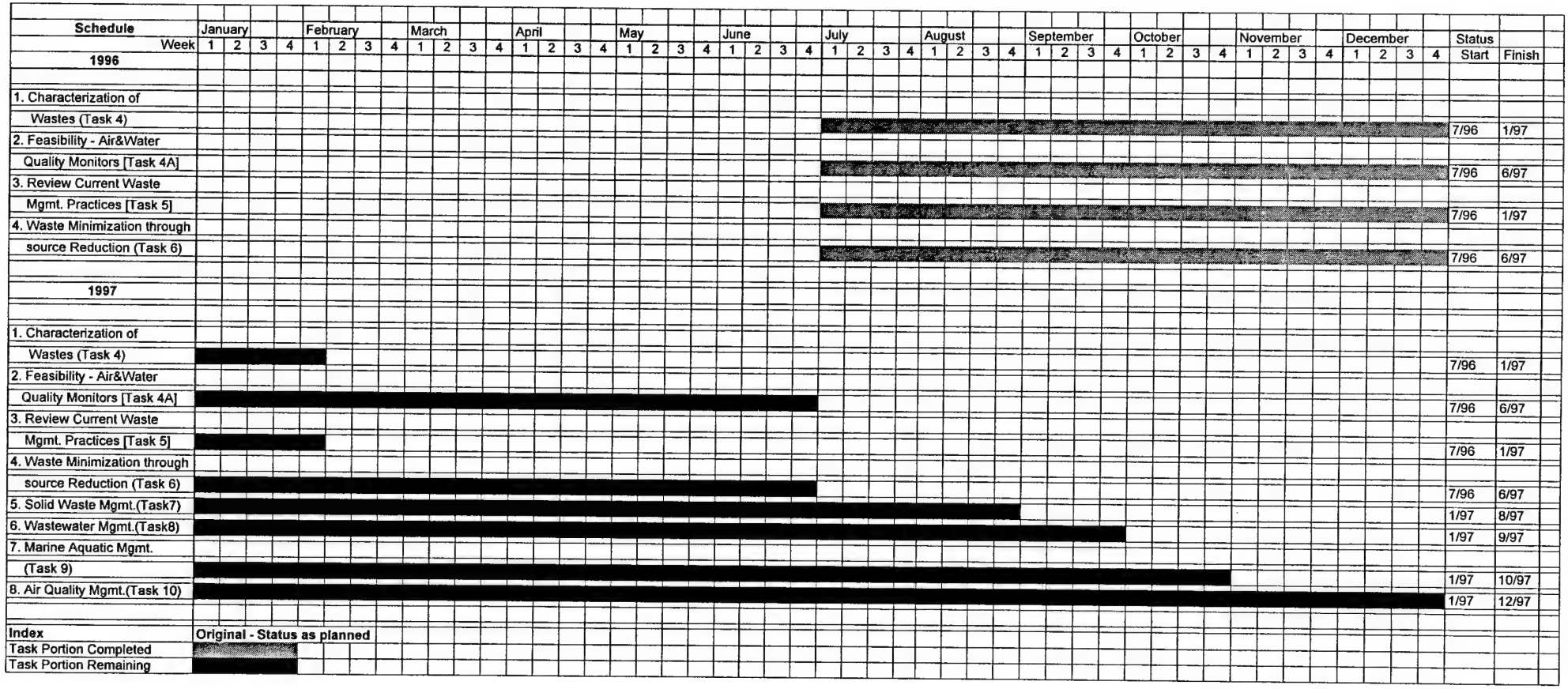
[b] Significant contacts made this quarter in the industry category were:

Mr. Frank Thorn	- Newport News Shipbuilding, Newport, VA
Mr. Juliam Bingham	- Alabama Shipyard, Inc., Mobile, AL
Mr. Timothy J. Welsh	- Atlantic Dry Dock Corporation, Jacksonville, FL
Ms. Jennifer C. Parker	- Bath Iron Works, Portland, ME

[c] Significant contact made this quarter in the government category was:

Mr. Robert Benze	- Puget Sound Naval Shipyards, Bremerton, WA

Integrated Environmental Management Plan for Shipbuilding Facilities



APPENDIX D

UNO-SWIFTSHIPS DEVELOPMENT OF A COST EFFECTIVE ALUMINUM CATAMARAN STRUCTURE

GCRMTC PROJECT No. AMTC95-010A

Principal Investigator:

Robert Latorre, Dr. Eng.
Naval Architecture and Marine Engineering

Additional Researchers:

Paul Herrington, Ph.D.
Department of Mechanical Engineering

Michael Folse, Ph.D.
Department of Civil and Environmental Engineering

University of New Orleans
New Orleans, LA 70148

D.1 PROJECT SYNOPSIS

Currently, U.S. shipbuilders are not competitive in the worldwide high speed passenger ferry market, while shipbuilders in many foreign countries have advanced the design of high speed catamarans to the point that they are marketing these craft worldwide. This project addresses the problem of developing a high speed catamaran design for the U.S. and worldwide passenger ferry market. It is focused on improving the productivity of U.S. shipyards by addressing the integration of catamaran design and manufacture through the research and development of an aluminum structural extrusion to reduce the number of components and the welding required, resulting in a lightweight high performance vessel.

D.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED	$186,517
FUNDS REMAINING	$1,500

D.3 ACCOMPLISHMENTS DURING CURRENT QUARTER

TASK I: MARKET OVERVIEW USING CATSSD DATA BASE AND SHIPYARD INPUT

The following market niche was determined from data based on the database results and shipyard input:

- Discussions with the principal industry collaborator on catamaran market, design, and construction for 1997 (12/7/96).

TASK II: PRELIMINARY DESIGN OF HULL STRUCTURE BASED ON DESIGN-RULE SPECIFIED HULL LOADS

- Completed optimization studies on aluminum hull panel.

TASK III: DEVELOPMENT OF RATIONAL CATAMARAN PLATE STRUCTURE USING STANDARDIZED ALUMINUM EXTRUSION(S) TO MINIMIZE SHIP PRODUCTION COSTS

- Instrument hull panel for test.
- Experimental test of hull panel (12/96).
- Analysis of test data (12/96).
- Correlation of experimental test and finite element results (12/96).

TASK IV: FINAL DESIGN FOR PRODUCTION WILL BE UNDERTAKEN

- Final design for production is being continually updated.

TASK V: TRAVEL TO SHIPYARDS/TECHNICAL CONFERENCES TO PRESENT RESULTS

- Paper entitled, "Development of a Production Optimization Program for Design and Manufacture of Aluminum Hull Panel," submitted to 1997 Ship Production Symposium (11/96).

- Workshop held 12/5/96 at International Workboat Show.

D.4 PROPOSED ACTIVITIES NEXT PERIOD

- Task VI: Preparation of final report.

D.5 COLLABORATIVE EFFORTS

	CURRENT QTR.	YTD
$ VALUE OF SERVICES FROM INDUSTRY:		
In-Kind Services:	$2,000	$53,000
Actual Funds:		
$ VALUE OF SERVICES FROM GOVERNMENT:		
In-Kind Services:	-	-
Actual Funds:		
NUMBER OF SIGNIFICANT CONTACTS:		
Industry:	5	21
Academic:	2	2
Government:	2	2

COMMENTS:

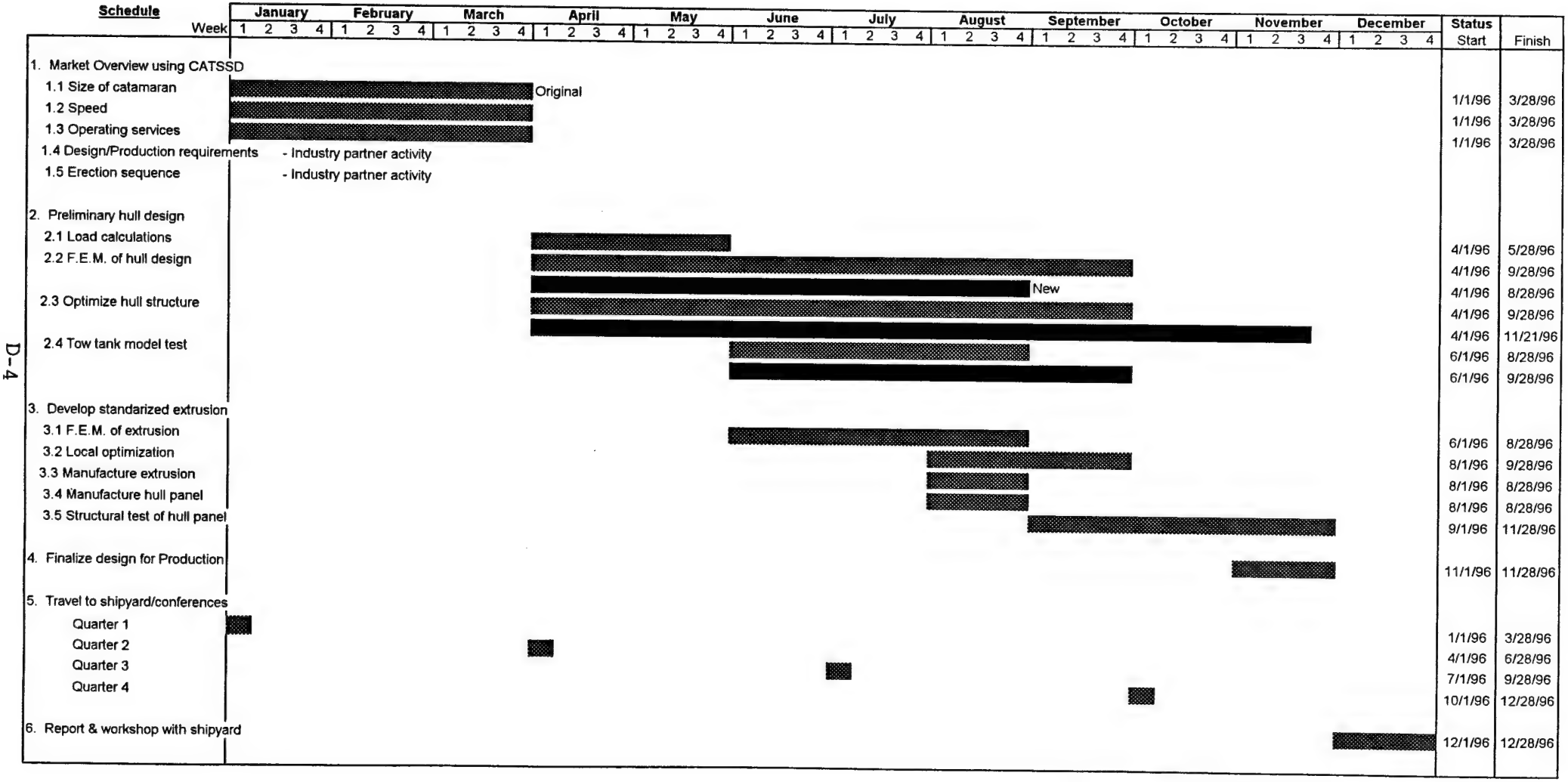
$ VALUE OF SERVICES FROM INDUSTRY:

- Swiftships, Inc. has agreed to materially participate in this project by participating in the catamaran panel test/analysis. The estimated cost is $2,000.

NUMBER OF SIGNIFICANT CONTACTS:

- Additional industry, academic, and government contacts were made as a result of the workshop held at the Workboat Show, New Orleans, LA.

UNO-Swiftships Development of a Cost Effective Aluminum Catamaran Structure Incorporating Extrusions



APPENDIX E

APPLICATIONS OF INTEGRATED OPTICAL FIBER SENSOR SYSTEMS IN SHIPBUILDING AND SHIPBOARD MONITORING

PHASE II

GCRMTC PROJECT NO. ATMC95-014A

Principal Investigator:

Shing Lee, Ph.D.
Department of Electrical Engineering

University of New Orleans
New Orleans, LA 70148

E.1 BRIEF SYNOPSIS

Fiber-optic sensor systems are compact, sensitive, and can be multiplexed throughout a ship to provide hazard warning, pollution and process monitoring, etc. This project investigates the applicability of shipboard monitoring using such systems. We have developed a novel fiber-optic sensor system based on in-line photopolarimetric measurements. The performance and cost issues have been addressed. The second phase of this project is to improve the existing sensors and to address the issues of sensor multiplexing in a large scale. In particular, fiber-Bragg grating systems will be investigated.

E.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED	$85,135
FUNDS REMAINING	$0

E.3 ACCOMPLISHMENTS DURING CURRENT QUARTER

TASK I: IMPROVE PHASE I SENSORS

Completed.

TASK II: NEW SENSOR REDESIGN

Completed.

TASK III: OBTAINING EQUIPMENT AND TECHNOLOGIES TO BUILD NEW SENSORS

The 480 mm focal length monochromator, manufactured by CVI Laser Corporation, arrived in mid-November 1996. This piece of equipment is funded by our industrial partner, Entergy Corp. Labview software has been developed for various routine functions of laboratory testing. It is being used to test Bragg-grating and pollution sensors.

A Sumimoto fusion splicer also arrived in November 1996. The bulk of the funds came from the College of Engineering, GCRMTC, Department of Electrical Engineering, and Entergy. It was critical in making prototypes for field testing.

A large donation of equipment has been obtained from the U.S. Department of Energy in supporting our fiber-optic sensor research. The equipment includes two pulse generators, three digital and storage oscilloscopes, a lock-in amplifier, three waveform digitizers, two manometer sensors, and a data acquisition system. The original cost of such equipment is over $300,000. We will be able to build and test large scale fiber-Bragg grating sensor systems in our laboratory.

TASK IV: PROTOTYPE FABRICATION AND TEST

Prototype fabrication and laboratory tests of evanescent-wave, fiber-optic, and polarimetric pollution sensors have been completed. In anticipation of using the fiber-Bragg grating sensors for shipborne monitoring, we have prepared strain and temperature sensors using fiber-Bragg gratings. The spectral characteristics of the ER-doped broadband source were measured using the monochromator. However, the ER-doped broadband source did not have the desired spectral characteristics, so the laser pump was sent back to the vendor for repair. The laboratory testing of these sensors was unfortunately delayed temporarily.

TASK V: FIELD INTEGRATION AND TEST

Pollution monitors were tested around the clock on the roof of the College of Engineering building. The tests were completed and the prototype will be delivered to Entergy Substations for flashover monitoring early next year.

Mr. Jovanovich of Omni Tech has promised to arrange installation of the fiber-Bragg grating sensor system onboard ships.

E.4 PROPOSED ACTIVITIES FOR NEXT QUARTER

1. The final report is being prepared.

2. The evanescent-wave fiber-optic sensors, as pollution monitors, have stirred some interest. We have collaborated with Dr. Rosenzweig of the Chemistry Department for development of chemical sensors and with Dr. Kura of Civil Engineering for detection of pollution in shipyards.

3. The Louisiana State University System Office of Academic Affairs and Technology Transfer has approved the filing for a U.S. patent for our in-line, all fiber-optic photopolarimeter using a fused 1 x 5 star coupler. We will continue to collaborate fully with them.

4. Continue to work with Ingalls Shipyard and Omni Tech for testing fiber-optic sensors on ships.

E.5 COLLABORATIVE EFFORTS

	CURRENT QTR.	YTD
$ VALUE OF SERVICES FROM INDUSTRY:		
In-Kind Services:		
Omni Tech allows us to use their fusion splicer and acts as our contact with Ingalls Shipyard	$3,000	$3,000

Actual Funds:

A collaborative effort with Entergy in developing evanescent pollution sensors		$60,500

$ VALUE OF SERVICES FROM GOVERNMENT:

In-Kind Services:

Fiber-Bragg gratings from NRL		$15,000
Test equipment from DoE	$300,000	$300,000

Actual Funds:

None.

NUMBER OF SIGNIFICANT CONTACTS:

Industry:

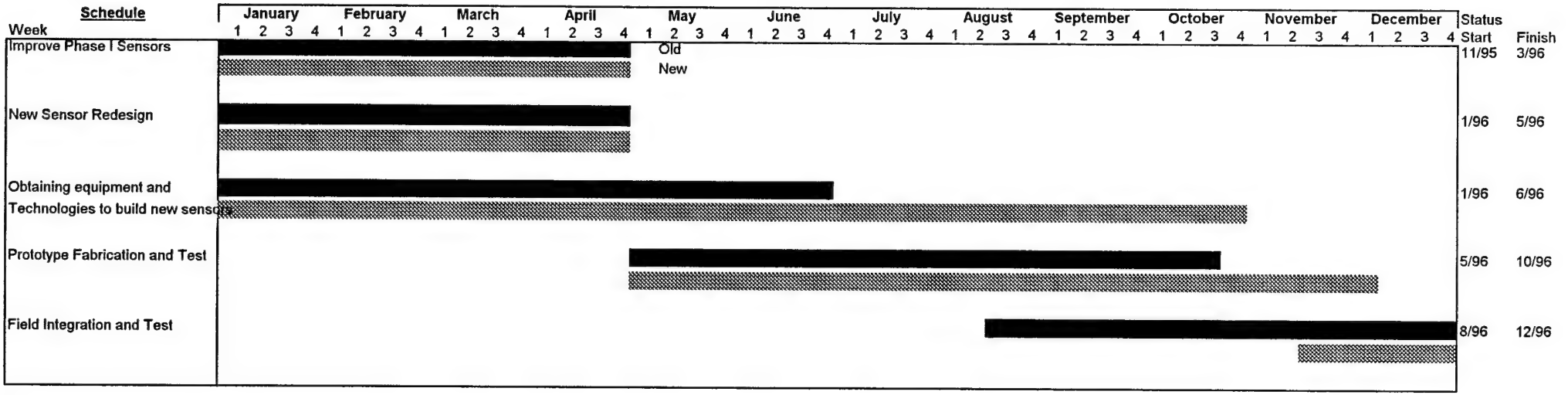
Ingalls,
Omni Tech,
3M,
Lasiris,
Electro TEK,
Innovative Fiber,
Newport.

Academic:

Government:

Dr. Allen Kersey, Naval Research Laboratory.

Applications of Integrated Optical Fiber Sensor Systems in Shipbuilding and Shipboard Monitoring (Phase II)



APPENDIX F

SHIPBOARD SENSORS

PHASE II

GCRMTC PROJECT NO. ATMC95-016A

Principal Investigator:

Russell E. Trahan, Ph.D.
Department of Electrical Engineering

Co-Principal Investigator:

Paul M. Chirlian, Eng. Sc.D., P.E.
Department of Electrical Engineering

Co-Investigator:

Kim Jovanovich
Omni Technologies, Inc.

University of New Orleans
New Orleans, LA 70148

F.1 PROJECT SYNOPSIS

This project is a continuation of "Project 16 - Shipboard Sensors," begun in 1995. The main thrust of the project is to develop fiber optics-based environmental sensors for shipboard use.

The tasks to be completed in the second phase of the project are as follows:

Task 1: Comparison Testing,
Task 2: Repackaging,
Task 3: Identify Vessels for Testing,
Task 4: Install Prototype System,
Task 5: Prototype System Evaluation,
Task 6: Progress and Final Reports.

F.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED:	$228,4760
FUNDS REMAINING:	$3,575

F.3 ACCOMPLISHMENTS DURING CURRENT QUARTER

TASK 1 OF PHASE II AND COMPLETION OF PHASE I ACTIVITIES

The testing of the commercial shipboard electrical sensors for temperature and smoke was delayed due to late delivery of the power supply necessary to power the system. The system components have been connected and tests will be completed before January 31, 1997.

We were informed that Securiplex will not allow UNO to purchase the MIL-SPEC sensors.

TASK 2 ACTIVITIES

Testing continued on the new temperature sensor in the environmental chamber at two optical wavelengths. The performance of the sensor was good except that the repeatability was not acceptable. At a given time the sensor was able to produce an accurate measurement of actual temperature; however, it was not possible to duplicate the results later. There appears to be some form of hysteresis in the sensor which causes a shift in the light output after the sensor is cycled through a low to high temperature test. In the interest of time, use of the delrin sleeve as an absolute temperature sensor was abandoned. We decided to use separate sensors for fixed temperature and temperature rate-of-rise. The fixed temperature sensor based on snap-disk technology, which was designed as part of the NRL fiber optics sensor suite, was incorporated into the system. Software was written to allow the use of the snap-disk sensor to measure a fixed temperature of 125^{o}F. The software for the delrin sleeve sensor was modified to determine only a temperature rate-of-rise. Both fixed temperature and rate-of-rise sensors are completed.

The smoke sensor hardware was finalized and minor changes to the software were made. Both prototype sensors work perfectly and meet specifications.

The flame sensor design has been completed and laboratory tested.

TASK 3 ACTIVITIES

The NRL/UNO/Omnicron Telecommunications sensors that were installed aboard the Shadwell in Mobile, AL were obtained from NRL at the Stennis Space Center in Mississippi.

Discussion continued with Ingalls Shipbuilding regarding the installation of the current fiber optic prototype sensor suite within a compartment aboard a Navy ship. The shipyard shut down over the holiday season and, therefore, the system will be installed aboard the USS Ross, DDG-71, during the first week of January.

F.4 PROPOSED ACTIVITIES FOR NEXT QUARTER

An extension into the first quarter of 1997 has been requested to complete the following:

1. Task 1: Comparison testing of the commercial electrical smoke and temperature sensors will be completed.
2. Task 2: Fiber optic temperature sensor evaluation and system interface will be completed.
3. Task 4: Sensors will be installed aboard USS ROSS, DDG-71.
4. Task 5: Data on shipboard system will begin to be collected.
5. Task 6: The final report will be written.

F.5 COLLABORATIVE EFFORTS

	CURRENT QTR.	YTD
$ VALUE OF SERVICES FROM INDUSTRY:		
In-Kind Services:	$10,500	$38,542
Actual Funds:		0
$ VALUE OF SERVICES FROM GOVERNMENT:		
In-Kind Services:		$500
Actual Funds:		0

NUMBER OF SIGNIFICANT CONTACTS:

Industry:

Dr. Emory Moore - Litton FiberCom
Perry Hayman - Ingalls Shipbuilding

Jimmy Hatzoglidis - Securiplex
Mark Ippolito - SOTEC

Academic:

Dr. Shing Lee - Department of Electrical Engineering, UNO

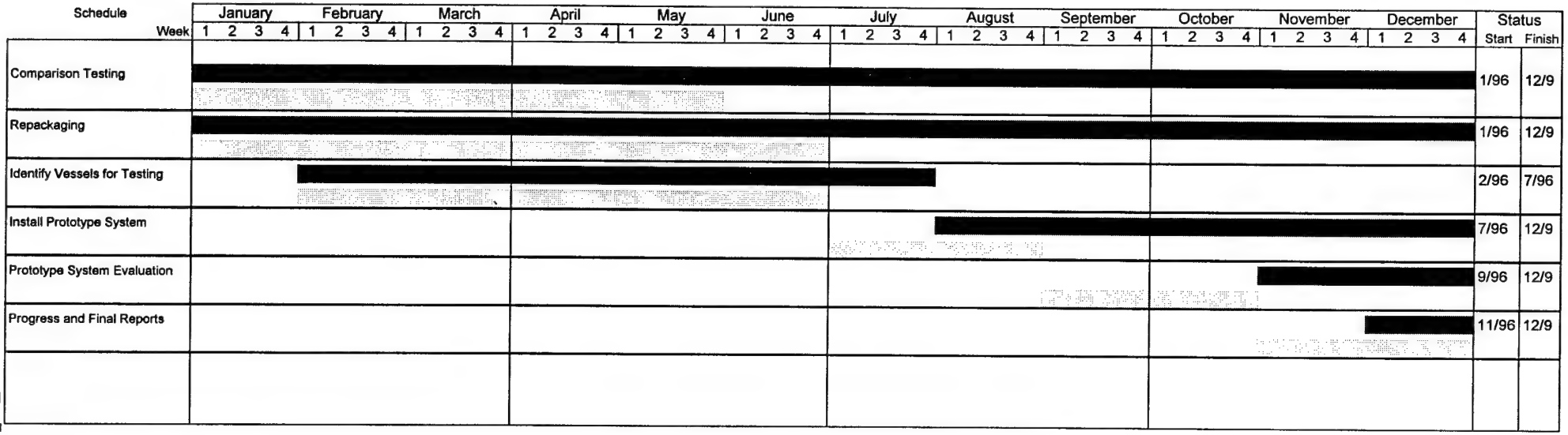
Government:

Mr. Steve Gibson - NRL, Stennis Space Center
Mr. Grant Bauer - NRL Director, Stennis Space Center

COMMENTS:

We have not been successful in combining the fixed temperature and rate-of-rise sensors into one. The repeatability of the temperature sensor is not adequate to measure absolute temperature. However, we have been able to complete the system using two sensors. The software has been completed and tested for all sensors and the system is ready for shipboard installation. An extension of this project has been requested to monitor the shipboard performance of the system.

SHIPBOARD SENSORS (PHASE II)



Updated February 6, 1997

Original Schedule

Modified Schedule

APPENDIX G

RELIABILITY, AVAILABILITY, AND MAINTAINABILITY (RAM) DATABASE/SHIPNET

PHASE II

GCRMTC PROJECT NO. AMTC95-018A

Principal Investigator:

Bahadir Inozu, Ph.D.
School of Naval Architecture and Marine Engineering

Additional Researchers:

Philippe Roy
Veronique Molinari
Scott Young
Iskender Gursoy
Ivan Radovic
Axel Stang Lund
Torstein Reinertsen
Dwi Priyanta
Sonja Draughn
Juan Manero
School of Naval Architecture and Marine Engineering

Linxiong Li, Ph.D.
Mathematics Department

Mont Echols, III
Computer Science Department

Ward Edwards, Ph.D.
Nejat Karabakal, Ph.D.

University of New Orleans
New Orleans, LA 70148

G.1 PROJECT SYNOPSIS

The purpose of this project is to set up and populate the integrated Reliability, Availability, Maintainability (RAM) Database and establish and activate the data exchange network SHIPNET. The overall objective of this project is to provide the marine industry with performance data on robust equipment to improve the total life cycle of ships in terms of safety, reliability, cost-effectiveness, and overall quality.

RAM/SHIPNET, a computer based system of RAM data collection, evaluation, and dissemination, consists of a network of integrated RAM databases connected to the master database located at GCRMTC. RAM/SHIPNET has been formed to facilitate the efficient collection, analysis, and sharing of vessel life cycle data and to promote consensus-building activities in the maritime industry.

G.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED	$408,986
FUNDS REMAINING	$29,834

G.3 ACCOMPLISHMENTS DURING CURRENT QUARTER

TASK I: DATE AND SHIPPER DEVELOPMENT/TEST AND MODIFICATIONS

DATE and SHIPPER, Version 2.1 Beta, were completed and delivered on November 27, 1996, after a 2-month testing period at UNO and implementation of a few additional modifications, including bar charts for trending analysis in SHIPPER's performance indicator sub-window. The Reliability, Operation and Maintenance division developed a new version of the on-line help with graphical support. DATE and SHIPPER, V2.1b, are currently under full scale testing at the headquarters of selected companies.

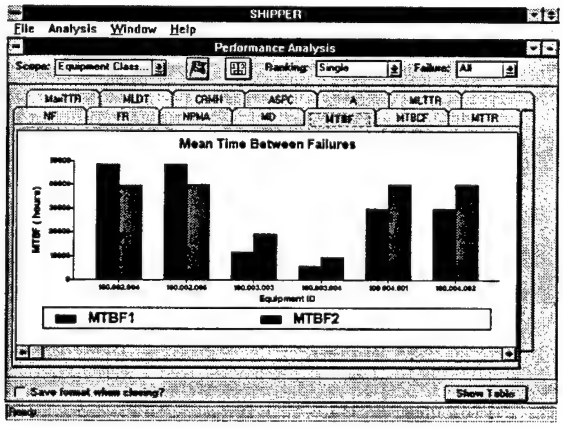


Figure 1. Performance Analysis Screen of SHIPPER

TASK II: SPIN AND SHIPS'S RAM DEVELOPMENT

Beta testing of SPIN, Version 1.0, has been completed. Specifications have been developed for the SPIN upgrade to comply with the new version of DATE. Diversified Computer Consultants started the code modifications in November 1996. The alpha version is scheduled to be delivered by December 25, 1996. Alpha testing and debugging are expected to last two months.

Specifications for SHIPS's RAM upgrade have been developed. SHIPS's RAM database will use the Sun Solaris version of Oracle in lieu of SPIN's PC version of personal Oracle. SHIPS's RAM will be completed and installed on a Sun Sparc Server 20 after the final release of SPIN 2.0 to avoid duplication of the RAM testing phases for SPIN and SHIPS. The alpha version of SHIPS's RAM was scheduled to be delivered by DCC by December 31, 1996.

Mr. Mont Echols of the Computer Science Department is in the process of upgrading the operating systems of our SUN servers and setting up the network for Oracle 7 and SHIPS's RAM installation and testing.

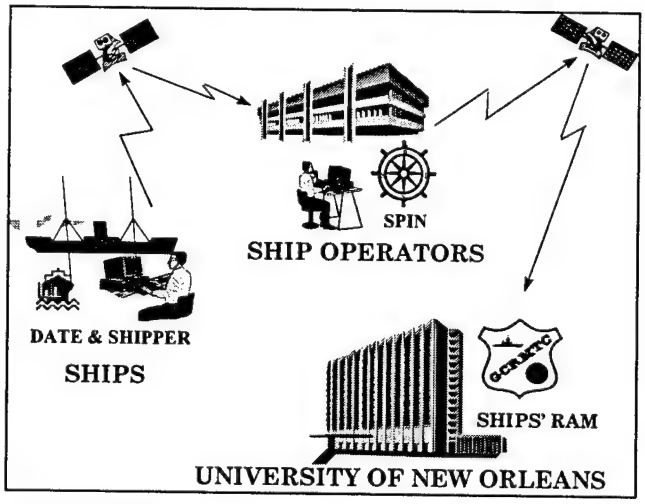


Figure 2. Data Flow Scheme

TASK III: DATE INTERFACES

The alpha version of the VRS interface code development has been completed. Initial testing revealed a need for code modifications for proper data transfer error handling. The DATE/VRS interface, Version 1.0 alpha, is expected to be delivered in late December 1996.

Specifications for the DATE/MMS Fleetworks interface have been revised based on various technical issues. Programming analysis and initial database connection protocol have been completed.

Sea-Land's Electronic Voyage Abstract (EVA) will be significantly modified for performance enhancement. EVA is being developed separately by Sea-Land's subcontractors. Changes are expected to be made on EVA's database structure. At the request of Sea-Land, DATE/EVA interface program development was put on hold until the release of EVA's new version.

Sea-Land requested double interface between DATE and AMOS-D. SpecTec, the company that developed AMOS-D, will periodically generate an ASCII text file which will contain the data to be transferred into the DATE program under an AMOS shell. The interface will be between the DATE watcom SQL database and SpecTec's ASCII file. As of December 16, 1996, technical issues are being solved and SpecTec is in the process of developing an estimate for the creation of the ASCII file generator.

A 10-week, no-cost extension of this phase was filed with GCRMTC to accommodate Sea-Land's requests and allocate adequate time for program testing, allowing for a smoother transition into the roll-out and implementation project.

Ship Breakdown Structure and Ship Life Cycle Modeling studies have been continued in cooperation with the USCG's Marine Safety Evaluation Program (MSTEP).

TASK IV: POPULATION OF RAM DATABASE

Preparation of a master database collection plan has been initiated. All participants have agreed to collect data concerning equipment failure on the major components of vessel main propulsion systems, electrical generation, and distribution systems and life saving systems as a minimum starting point.

TASK V: ANALYSIS OF RAM DATA

The pilot study for ETG's main condensate pumps has been revised to include new cost information as well as additional failure and maintenance data. An advanced life cycle cost analysis program was developed at UNO to investigate various maintenance and purchasing options. A special preliminary report was sent to ETG in November 1996. ETG requested an extension on the scope of this study to incorporate new cost and failure information.

Preliminary analysis of RAM data on ARCO's main boiler feed pump has been completed. The manufacturer is currently examining the failure information that was forwarded in September 1996.

TASK VI: CREATION OF RAM/SHIPNET HELP DESK

An intranet is being developed for the project participants allowing access to members only. The new address of the web site is http://www.uno.edu/~engr/ram/shipnet.htm.

A special search was conducted on variable speed drives to improve the reliability of main condensate pumps at the request of a participant.

A tutorial and user's guide have been prepared for DATE and SHIPPER, V.2.1 beta, and delivered to project participants. A video version of the tutorial is also being prepared.

TASK VII: SEM TRAINING/STRATEGIC PLANNING/BUILD ONE REQUIREMENT DEFINITION

The second phase of SEM training was held at MITAGS during the SOCP meeting on October 22 - 24, as part of strategic planning session #2 with the help of Rockwell International, which became Boeing North American. Major Units of Functionality (UoF) have been identified and a selected UoF has been derived at this session. An organizational structure and business plan for the roll out and implementation phase have been discussed. The following vision statement has been derived for RAM/SHIPNET:

> *To produce, profitably operate, and maintain the optimal, worldwide information network on ship machinery and structures to support the optimization of safety, reliability, and cost effectiveness throughout all stages of a vessel's life cycle.*

A meeting was held at Deloitte & Touche on December 11, 1996, to discuss various incorporation alternatives. In addition, conference calls held on November 6 and 12 and December 17, 1996, addressed legal and administrative issues for the implementation structure.

The training task group made various conference calls and held a special meeting on October 6 - 7, 1996. The strategies were evaluated for various training needs.

The standardization task group attended the ASTM F25 meeting on Ship Operations Data Modeling, held on December 11, 1996.

TASK VIII: INTERNATIONAL SHIP NETWORK DEVELOPMENT - PHASE IV

Contacts have continued with various shipping organizations and classification societies.

G.4 PROPOSED ACTIVITIES FOR NEXT PERIOD

1. Continue testing new versions of SPIN and SHIPS's RAM at GCRMTC.
2. Continue full scale testing of DATE and SHIPPER, Version 2.1, at company headquarters.
3. Test VRS/DATE interfaces and develop the code for MMS Fleetworks interface for ARCO.
4. Develop the code for AMOS-D Interface for Sea-Land.
5. Continue development of training workshops on selected areas.
6. Continue structural development of the non-profit corporation and implement.
7. Finalize the participation agreement.
8. Continue the development of the business plan.
9. Continue preparation of a master data collection plan and start data collection accordingly.
10. Continue involvement with standards development via ASTM F25 and related ISO activities.

G.5 COLLABORATIVE EFFORTS

	CURRENT QTR.	YTD
$ VALUE OF SERVICES FROM INDUSTRY:		
In-Kind Services:		
SOCP/Energy Transportation Group	$19,750	$72,850
SOCP/Sea-Land Service, Inc.	$900	$14,500
SOCP/ARCO Marine, Inc.	$9,000	$33,750
Actual Funds:		
SOCP (Cont.) $69,189 + PRC Management		

$ VALUE OF SERVICES FROM GOVERNMENT:

In-Kind Services:

Actual Funds: Same as above.

Note: SOCP is an industry-government cooperative program.

NUMBER OF SIGNIFICANT CONTACTS: (Total 29)

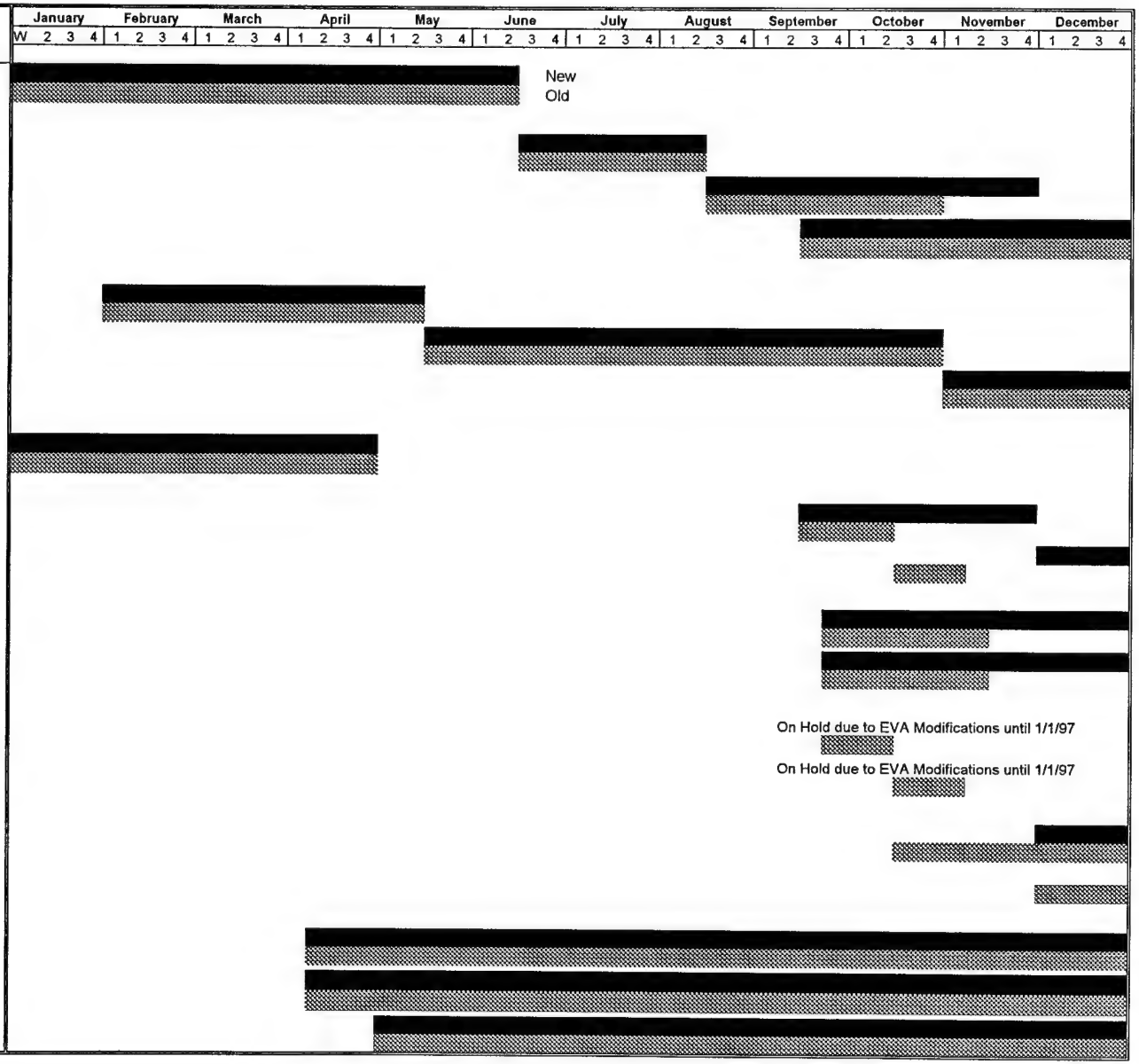
Industry:	
P.G. Schaedel and Don McLendon	Energy Transportation Group
M. Bohlman and Lynn Rambeau	Sea-Land
Kim Estes, Frank Lee, and Matthew MacDonald	ARCO Marine
R. Conachey, A.K. Seah, John Conlon, David W. Robinson, and E. Reilly	ABS
G. Jones and Dr. Z. Bazari	Lloyd's Register
Egil Rensvik and Roar Henningsen	MARINTEK
Terje Sten and Helge Audun Sandtorv	SINTEF
Magne Sigurdsen, Jon Rysst, Tor Erik Andersen, Rolf Skjong, and Terje Staalstrom	DNV
Academic:	
Prof. Magnus Rasmussen	NTNU
Government:	
J. Zok, P. Randall, and John Dumbleton	MARAD
Z. J. Karaszewski and Robb Wilcox	USCG - National Maritime Center

SCHEDULE MODIFICATIONS:

The pilot study for ETG has been expanded because of new failure data and price changes. Sea-Land has requested us to give them more time before we complete program integration due to their major internal program modifications. ARCO has experienced a change in personnel affecting their SOCP representative and their commitment to our predefined schedule for the current phase.

Reliability, Availability, Maintainability (RAM) Database/SHIPNET as of December 9, 1996 (1 of 2)

Schedule	Status Start	Finish
1 DATE & SHIPPER V. 2.0 Beta testing at shore based SOCP Sites	1/1/96	6/10/96
	1/1/96	6/10/96
2 Final Modifications of DATE & SHIPPER V. 2.0		
2.1 Code Development	6/10/96	8/16/96
	6/10/96	8/16/96
2.2 Testing at GCRMTC	8/16/96	11/27/96
	8/16/96	10/31/96
3 Full scale DATE & SHIPPER v. 2.1 Beta testing on board (Ph. I)	9/16/96	12/31/96
	9/16/96	12/31/96
4 SPIN & SHIP's RAM softw. development		
4.1 Code development for V. 1.0 Beta	2/1/96	5/12/96
	2/1/96	5/12/96
4.2 Beta tests of V. 1.0 Beta	5/12/96	10/31/96
	5/12/96	10/31/96
4.3 Modification of SPIN & SHIPS' RAM	10/31/96	3/15/97
	10/31/96	12/31/96
5 DATE Interfaces		
5.1 Survey to examine current formats	12/1/95	4/30/96
	12/1/95	4/30/96
5.2 VRS Interface for ARCO		
5.2.1 Development of Interface module for VRS	9/18/96	12/25/96
	9/18/96	10/15/96
5.2.2 Test of interface module for VRS	12/1/96	12/31/96
	10/15/96	11/7/96
5.3 MMS Fleetworks Interface for ARCO		
5.3.1 Database Analysis	9/24/96	12/31/96
	9/24/96	11/15/96
5.3.2 Database Connection	9/24/96	12/31/96
	9/24/96	11/15/96
5.4 Voyage abstract Interface for S/L		
5.4.1 Development of Interface module for EVA	9/24/96	3/15/97
	9/24/96	10/15/96
5.4.2 Test of interface module for EVA	2/15/97	3/15/97
	10/15/96	11/7/96
5.5 AMOS - D Interface for S/L		
5.5.1 Development of Interface module for AMOS-D	10/15/96	1/31/97
	10/15/96	12/31/96
5.5.2 Test of interface module for AMOS-D	1/31/96	2/27/97
	12/1/96	12/31/96
6 Customization of DATE		
6.1 for ETG	4/7/96	12/31/96
	4/7/96	12/31/96
6.2 for ARCO	4/7/96	12/31/96
	4/7/96	12/31/96
6.3 for S / L	5/1/96	12/31/96
	5/1/96	12/31/96



Reliability, Availability, Maintainability (RAM) Database/SHIPNET as of December 9, 1996 (2 of 2)

Schedule	Status Start	Status Finish
7 Development of Data entry Guidelines		
7.1 General Guidelines	2/9/96	11/27/96
	2/9/96	10/7/96
7.2 Company Specific Guidelines for ETG	4/5/96	12/31/96
	4/5/96	11/16/96
7.3 Company Specific Guidelines for ARCO	4/1/96	12/31/96
	4/5/96	11/16/96
7.4 Company Specific Guidelines for S/L	4/16/96	12/31/96
	4/5/96	11/16/96
8 Site visits for initial surveys		
8.1 ARCO	12/11/95	4/8/96
	12/11/95	4/8/96
8.2 S/ L	12/1/95	5/30/96
	12/1/95	5/30/96
8.3 ETG	11/1/95	5/22/96
	11/1/95	5/22/96
8.4 ABS	1/30/96	6/1/96
	1/30/96	6/1/96
9 Pilot studies for RAM data analysis		
9.1 Feed Pump Pilot Study for ARCO	12/1/95	12/31/96
	12/1/95	12/31/96
9.2 Condensate pump pilot study for ETG	11/1/95	12/31/96
	11/1/95	10/31/96
10 MSTEP Interface		
10.1 Defining Roles	4/12/96	2/1/97
	4/12/96	10/31/96
10.2 Ship Break Down Structure Modeling - Part 1	9/4/96	2/27/97
	9/4/96	2/27/96
10.2 Ship Life Cycle Modeling - Part 1	9/4/96	2/27/97
	9/4/96	2/27/96
12 RAM/SHIPNET Help Desk- Phase I	5/10/96	12/31/96
	5/10/96	12/31/96
13 International Ship Network Development- Phase IV	1/1/96	12/31/96
	1/1/96	12/31/96
14 Consensus Meetings at UNO (Guidelines/MSTEP/SHIPNET)	5/6/96	5/22/96
	5/6/96	5/22/96
15 SEM Training	6/1/96	8/21/96
	6/1/96	8/21/96
16 Strategic Planning - Phase I	6/1/96	12/31/96
	6/1/96	8/21/96
17 Regular RAM DB Population - Phase I	11/15/96	12/31/96
	11/15/96	12/31/96

APPENDIX H

SOFTWARE APPLICATIONS FOR SHIPBUILDING OPTIMIZATION

PHASE II

GCRMTC PROJECT NO. AMTC95-027A

Principal Investigator:

Norman L. Whitley, Ph.D.
Department of Mechanical Engineering

University of New Orleans
New Orleans, LA 70148

H.1 PROJECT SYNOPSIS

This proposal calls for the investigation of current shipbuilding methodology and the incorporation of computer-based procedures in shipbuilding design and manufacture.

H.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED:	$143,900
FUNDS REMAINING:	$42,631

H.3 ACCOMPLISHMENTS DURING CURRENT QUARTER

TASK 1: IMPROVE PRODUCTIVITY

Software and hardware were purchased to make the Advanced Computer Laboratory for Shipbuilding (ACLS) more flexible, powerful, and productive. Two SCSI internal hard drives were purchased for two of the Pentium machines in the ACLS. LINUX, a non-proprietary operating system installed on these machines, is a UNIX environment for machines with Intel-type hardware. This operating system is a major addition to world PC's. In particular, it will allow our PC's to communicate with the DEC AlphaStation in an X11 graphical user interface (GUI). Also added was an external Iomega Jaz drive to the DEC AlphaStation. This SCSI drive will allow routine backups of the code to be done on the AlphaStation. It will also allow us to port code to and from the machine more quickly, as well as allow for archiving of modules as they develop.

TASK 2: CAS.CADE CODE GENERATION

In tackling a specific goal instead of a generic one, we have focused our efforts on a prototype module to design container ships, starting with the parallel mid-body sections. We have done this deliberately by starting with the specifications of the CAD system - about 40 pages of how a mid-body section could be designed. Such specifications should reflect a shipyard's experience, its strengths, and its manufacturing processes. After the specifications are written, it becomes clear what methods, both numerical and graphical, should be included in the prototype.

Our class hierarchies have two templates. The basic geometric and topological classes are taken from STEP Part 42. The ship structural application protocols are being modeled after the NSRP STEP applications protocols for structures.

A preliminary design module is included in a package that will use time-tested empirical formulae by which the overall dimensions of a ship with a certain mission are determined. We are using the ones from Lloyd's Registry of Shipping (LRS).

Also being built into the CAD package are methods that reflect classification design rules and/or shipyard practices. Many parameters that are free to choose in a ship design are connected by design rules. For example, when a designer picks a hull plate thickness, that choice influences what he/she can later pick

about hull stiffeners. Overall rigidity of the hull is designated by the design rules and not by basic choices. The goal is to have algorithms that automatically satisfy design rules, thereby ensuring that the design will be acceptable.

The methods of these class objects are being developed within DRAW, which is a 3D wireframe environment wherein one can see quickly the results of writing C++ methods. Using the specifications in which the methods are indicated, we can write the necessary code, run it in DRAW to see if it works as desired, and debug it quickly. This is a fast turnaround process because it enables one to rapidly create the algorithms that are needed without continually having to write interfaces that use all the supporting GUI and database environment.

TASK 3: EXPERT SYSTEM DEVELOPMENT

A working prototype of this expert system is being developed. A graduate student will complete this task during the next quarter.

TASK 4: TRIPS/MEETINGS/CONTACTS

Claude Hessenet of Matra/Datavision visited the GCRMTC on October 2, 3, and 4, during which time we received some training. A major portion of the time was spent working on the specifications of our prototype system. Mr. Hussenet shared his experience in the best ways to develop these important documents.

We also spent a large amount of time learning about the DRAW environment (mentioned above).

Dr. Whitley attended the combined SP-4, SP-6, and SP-8 panel meetings in Mobile, AL during October. The super projects that these engineering panels will submit to the NSRP ECB will include the following:

1. A project on predicting and controlling material shrinkage and warping during manufacturing,

2. A project on making a formal choice from various existing standards for a U.S. commercial standard for shipbuilding,

3. A project to promote EDI among U.S. shipyards, their customers, suppliers, and vendors. Each of these holds possibilities for our developing CAD and a manufacturing laboratory.

Dr. Whitley submitted a draft to the technical review committee of the 1997 Ship Production Symposium, titled "A Prototype Object-Oriented CAD System for Shipbuilding," which reviews the thrust and achievements of this project.

H.4 PROPOSED ACTIVITIES FOR NEXT PERIOD

There are no proposed funded activities for the next period, other than the graduate student referred to in Task 3, above.

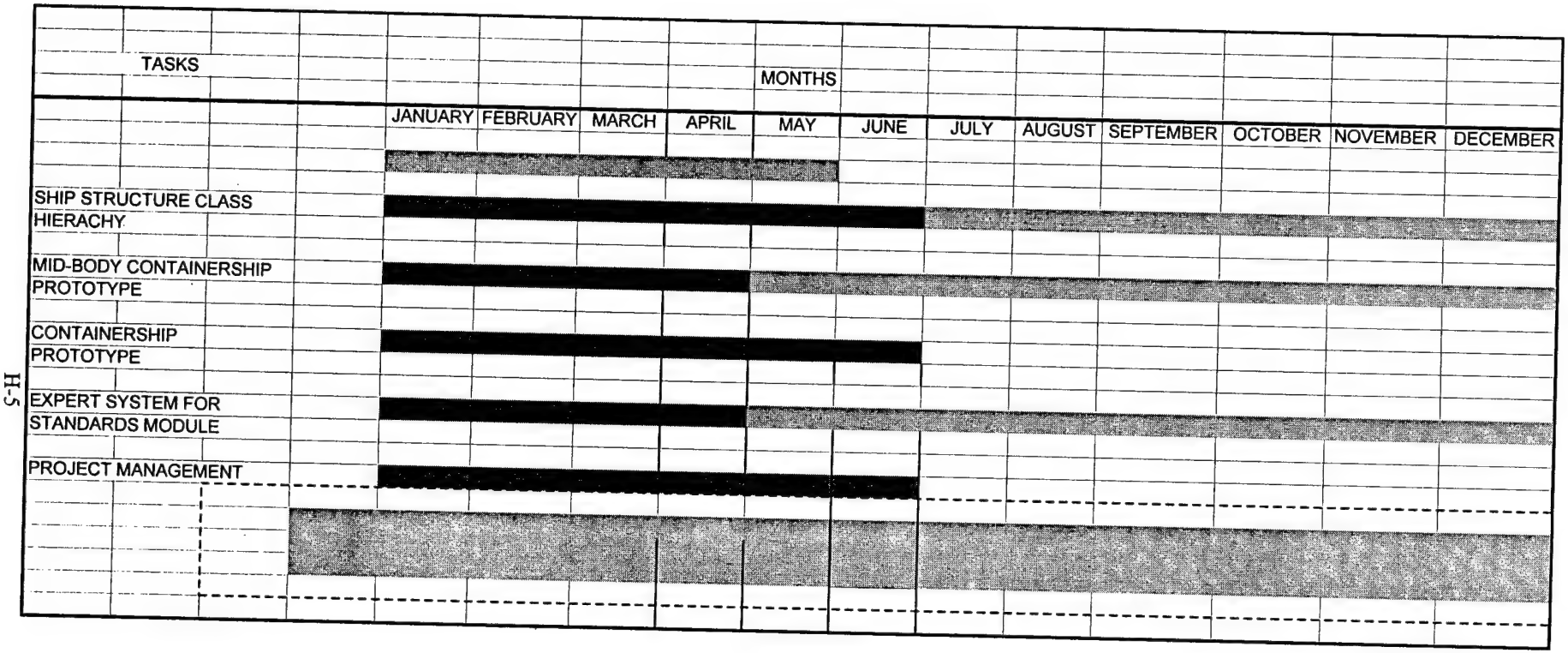
H.5 COLLABORATIVE EFFORTS

	CURRENT QTR	YTD
$ VALUE OF SERVICES FROM INDUSTRY:		
In-Kind Services:	0	0
Actual Funds:	0	0
$ VALUE OF SERVICES FROM GOVERNMENT:		
In-Kind Services:	0	0
Actual Funds:	0	0
NUMBER OF SIGNIFICANT CONTACTS:		
Industry:	4	22
Academic:	2	4
Government:	2	14

COMMENTS:

Mr. Claude Hussenet of Matra Datavision provided support totaling 20 hours.

SOFTWARE APPLICATIONS FOR SHIPBUILDING OPTIMIZATION



APPENDIX I

IMPROVING TECHNOLOGY TRANSFER IN THE SHIPBUILDING INDUSTRY

PHASE II

GCRMTC PROJECT AMTC95-030A

Principal Investigator:

William Lannes, P.E.
College of Engineering

Co-Principal Investigator:

James Logan, Ph.D.
College of Business, Department of Management

University of New Orleans
New Orleans, LA 70148

I.1 PROJECT SYNOPSIS

The purpose of this project is to develop an improved technology transfer process incorporating change management techniques for use in the shipbuilding industry. The deliverables from this project consist of an improved technology transfer process which incorporates industry best practices and current knowledge of organizational change into a matrix evaluation model and its accompanying implementation protocol. The process incorporates financial, technical, and behavioral factors into a normative model designed to enhance organizational technology transfer.

The model is for use by firms in the shipbuilding industry to evaluate current firm practices against best practices and to identify target areas for improvement within a firm. The improved process model identifies significant stakeholders in the technology transfer process and incorporates their needs. To ensure maximum usability, the model can be customized according to the requirements of an individual firm.

Additional benefits of this project are the generation of a current, focused data base on the subject of technology transfer in the shipbuilding industry as well as increased understanding, within both the College of Business and the College of Engineering at the University of New Orleans, of a very significant regional industry.

I.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED:	$133,492
FUNDS REMAINING	$34,000

I.3 ACCOMPLISHMENTS DURING CURRENT QUARTER

FIELD TEST AT INGALLS SHIPYARD

The prototype Innovation Quotient (IQ) system and software was utilized by a 6-person advanced development group in the research and development section of Ingalls. The test was designed both to field test the software and system and to gather improvement suggestions for software wording and presentation.

FACILITATED FEEDBACK SESSION ON RESULTS WITH THE IQ SYSTEM TO THE R&D GROUP AT INGALLS SHIPYARD

The results from the initial field test were analyzed, presented to the R&D group, and recommendations were made for possible improvements in their innovative capacity.

VERBAL AND WRITTEN COMMENTS COLLECTED FROM USERS AT INGALLS SHIPYARD UPON COMPLETION OF FACILITATED FEEDBACK SESSION

The users were observed and questioned, and comments were recorded during the facilitated feedback question. In addition, questionnaires were left with the participants so that their comments on the system could be captured after some reflection.

CHANGES IN WORDING OF QUESTIONS IN SOFTWARE SYSTEM AS RECOMMENDED BY USERS IN FIELD TEST

In the field test, the users pointed out phrases that were confusing or could be improved, and also changes that they felt needed to be made in the overall esthetics of the program. The changes in the questions and correction of phrases and consistency in wording have been made to the software. The changes in program esthetics will be accomplished in a follow-on project.

ADDITIONAL SITES FOR FIELD TESTING

Additional sites for field testing were arranged with Petrocom, Inc., a small high technology communications firm that operates in a marine environment. Additionally, discussion is ongoing with the advanced development group of McDermott Shipbuilding concerning a suitable time for field testing. A "no additional cost" extension was granted by the GCRMTC to accomplish the field tests in January.

PAPERS ACCEPTED FOR PUBLICATION

1. "A Computer-Aided Process for Assessing the Ability of Shipyards to Use Technological Innovation," at the 1997 Ship Production Symposium.

2. "Innovation, Technology Transfer, and Reward Systems: A Preliminary Study of the United States Shipbuilding Industry," at the 1997 Annual Meeting of the Southwest Institute of Decision Sciences.

PRESENTATION TO GCRMTC GOVERNMENT/INDUSTRY ADVISORY BOARD

A presentation, "Using the Innovation Quotient to Assess Innovation in U.S. Shipbuilding Companies," was made to the GCRMTC GIAB and invited industry guests on December 12, 1996.

I.4 PROPOSED ACTIVITIES FOR NEXT PERIOD

1. Accomplish additional site visits in January. These prototype tests will be completed in January and the data will be added to the final report.

2. Finish end of project report.

3. Finish proposal for follow-on project.

I.5 COLLABORATIVE EFFORTS

	CURRENT QTR.	YTD
$ VALUE OF SERVICES FROM INDUSTRY:		
In-Kind Services:	$610	$2,610
Actual Funds:	–	–
$ VALUE OF SERVICES FROM GOVERNMENT:		
In-Kind Services:	–	–
Actual Funds:	–	–
NUMBER OF SIGNIFICANT CONTACTS:		
Industry:	27	148
Academic:	3	15
Government:	0	3

COMMENTS:

Specific interaction occurred with the following industries and other organizations:

- Ingalls Shipyard,
- McDermott Shipbuilding, Inc.,
- Petrocom, Inc.,
- GCRMTC Project 95-27,
- Mike Landon & Associates,
- SP Reports,
- 1997 Ship Production Symposium,
- GCRMTC Orange Site,
- GCRMTC GIAB,
- Decision Sciences Institute.

Most contacts and in-kind time contributions were made in the first year of this project. Additional industry contacts will be made in the current phase of the project as the system is used with industry participants.

Improving Technology Transfer in the Shipbuilding Industry

Schedule	Status		January	February	March	April	May	June	July	August	September	October	November	December
	Start	Final	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
Literature Review	1/1/95	4/1/95												
Trial Field Interviews	2/1/95	4/30/95												
Instrument Development	4/1/95	6/1/95												
Survey & Analysis	6/1/95	11/15/95												
Prototype Model	10/1/95	12/31/95												
			January	February	March	April	May	June	July	August	September	October	November	December
			1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4	1 2 3 4
Prototype Test	1/1/96	6/1/96												
Expert Sys. Development	10/1/95	12/31/96												
Iterative Changes	3/1/96	11/1/96												
Field Implementation	6/1/96	11/1/96												
Final Report	11/1/96	12/31/96												

APPENDIX J

LOW COST DIGITAL IMAGE PHOTOGRAMMETRIC TECHNOLOGY IN SHIPYARDS

GCRMTC PROJECT NO. AMTC95-035A

Principal Investigator:

Clifford D. Mugnier, C. P.
Department of Civil and Environmental Engineering

University of New Orleans
New Orleans, LA 70148

J.1 PROJECT SYNOPSIS

Photogrammetry is an attractive technology in shipyard applications, but high-priced systems (+$100,000) discourage most shipyards. Interface software will be developed to adapt inexpensive topographic mapping applications for industrial applications to be used in shipyard production environments. A series of "successes" with an industrial collaborator will serve as instructional material useful in the dissemination of easy, low-cost dimensional control using digital image photogrammetry.

J.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED:	$166,544
FUNDS REMAINING:	$103,271

J.3 ACCOMPLISHMENTS DURING CURRENT QUARTER

TASK I: PURCHASE AND INSTALL DEVELOPMENT SOFTWARE

All software purchased has now been installed.

TASK II: SOFTWARE DESIGN

The software design is on schedule. The timeline for this task needs to be extended through the end of the first week of the third quarter because of new projects that were started (and completed) with shipyards.

TASK III: SOFTWARE DEVELOPMENT

Development of the menu system will begin the first week of the third quarter because of new projects started and completed with shipyards.

TASK IV: ROBOHELP DOCUMENTATION

This task is continuing.

J.4 PROPOSED ACTIVITIES FOR NEXT QUARTER

1. Complete Task II, Software Design of the menus for Windows system for shipbuilding applications.

2. Continue Task III, Software Development of the menus for Windows.

3. Continue Task IV, RoboHelp Documentation based on Windows development and RoboHelp menus.

4. Start new projects with shipyards as they occur (as needed).

J.5 COLLABORATIVE EFFORTS

	CURRENT QTR.	YTD
$VALUE OF SERVICES FROM INDUSTRY:		
In-Kind Services from Industry:		
Bender	$6,035	$ 6,035
Bollinger & A. K. Suda	$20,000	20,000
Avondale Shipyards	$1,500	1,500
		$27,535

COMMENTS:

1. As part of the continuing effort to work with industry partners, Avondale Industries, Inc. is working with us to develop an "as-built" 3-D CAD model of an actual working engine room for an interference check. To date, three visits have been made to the ship, the last two visits being photography sessions. Data analysis was still underway.

2. The project with Bender Shipbuilding & Repair Co., Inc. has been completed (see letter attached).

3. The project with Bollinger Shipbuilding and A. K. Suda, Inc. has been completed.

4. The project with Chevron, Inc. (laser system) has been shelved based on further hardware development. The system is a LIDAR-based system with some knotty problems due to systematic errors. If they are able to correct their curvature of field problem, the system could have a major impact on "as-built" surveys. This system will only work, however, on static structures; it will not be suitable for objects in motion.

Bender Shipbuilding & Repair Co., Inc.
Engineering Department
265 South Water Street, Mobile, AL 36603 • P.O. Box 42, Mobile, AL 36601
Telephone: (334) 431-8743 • Telecopier: (334) 431-8903

December 11, 1996

Mr. Clifford J. Mugnier
Certified Photogrammetrist
University of New Orleans
Department of Civil & Environmental Engineering
415 Engineering Building
New Orleans, LA 70148

Subject: Bender Job No. 6573
M/V AEGEO
Photogrammetric Survey

Dear Mr Mugnier:

We appreciate your quick response to our commercial needs to obtain 3-D geometry to define vessel shell plate repair. Our "in kind" contribution for this project is 71 manhours at $85.00 per hour. The evaluation of ship checked dimensions to verify photogrametry determined dimensions is in progress and can be reported at a later date.

If I can be of any other assistance please do not hesitate to call me at 334-431-8743.

Sincerely,

BENDER SHIPBUILDING & REPAIR CO., INC.

JOSEPH H. COMER
Engineering Manager

cc: K. Wise Job 6573 File

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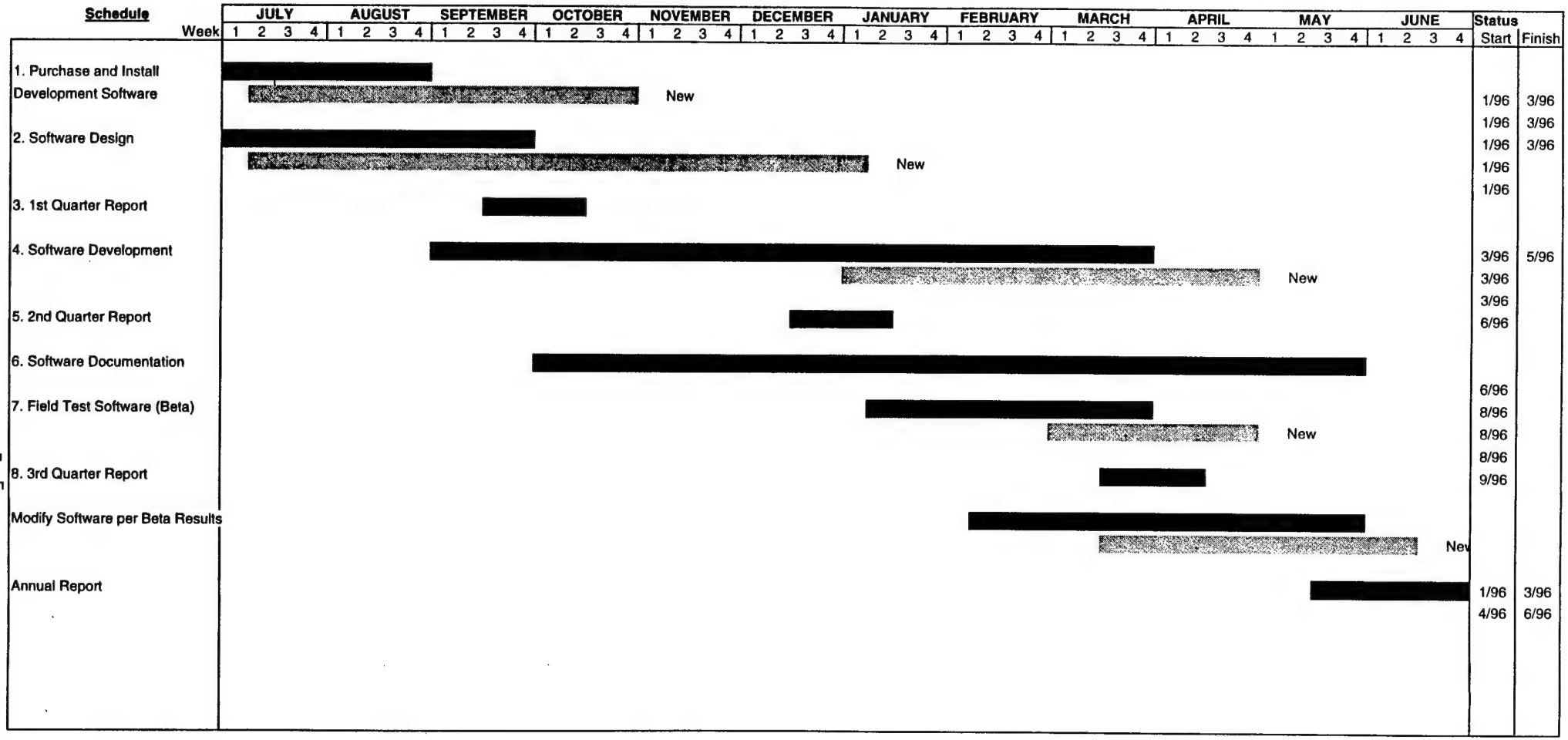
Low-Cost Digital Image Photogrammetry



APPENDIX K

SHIP CAPSIZING
(AN ACCURATE AND EFFICIENT TECHNIQUE TO PREDICT SHIP ROLL DAMPING)

GCRMTC PROJECT NO. AMTC-036A

Principal Investigator:

Jeffrey M. Falzarano, Ph.D.
Department of Naval Architecture and Marine Engineering

Co-Principal Investigator:

Richard A. Korpus, Ph.D.
Senior Research Scientist, Marine Hydrodynamics (SAIC, Ship Technology)

Additional Researcher:

Robert M. Fithen, Ph.D.
Department of Mechanical Engineering

University of New Orleans
New Orleans, LA 70148

K.1 PROJECT SYNOPSIS

This project will develop an accurate and efficient technique to predict ship roll damping using the Finite Analytic Reynolds Averaged Navier Stokes (FA-RANS) solution technique. This capability will improve naval and commercial hull form design with regard to minimizing the most critical resonant roll motions and loads. The approach to be used will be to apply progressively more accurate yet computer intensive approximations. Existing results will be compared with data to be obtained from model and full scale tests. Extensive use will be made of existing SAIC capability and UNO experimental and computer resources including the newly installed UNO Cray J916.

K.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED	$247,877
FUNDS REMAINING	$117,934

K.3 ACCOMPLISHMENTS DURING CURRENT QUARTER

Work continued on the second year's tasks which included the following three areas:

1. Development - Completed 3-D submerged oscillating body with forward speed. Began surface piercing body.

2. Applications - Completed McDermott application and Rankine ovoid under free surface.

3. Validation - Compared our McDermott results with Netherlands Ship Model Basin (NSMB) model tests and compared with David Taylor Research Center (DTRC) experimental results Rankine ovoid with forward speed under free surface.

The approved paper presented to the 15th ASME OMAE is scheduled for publication in the February issue of *ASME Transactions Journal of Offshore Mechanics and Arctic Engineering.*

K.4 PROPOSED ACTIVITIES NEXT QUARTER

1. Development - Plan to complete surface piercing body computer code.

2. Applications - Plan to repeat McDermott application for oscillating submerged body beneath the free surface, including comparison with model tests results that they have available.

3. Validation - Depending upon towing tank availability, we plan to build a 2-D model and use existing Planer Motion Mechanism (PMM). Depending upon availability of the McDermott vessel, we also will do a full scale trial.

K.5 COLLABORATIVE EFFORTS

	CURRENT QTR.	YTD
$ VALUE OF SERVICES FROM INDUSTRY:		
In-Kind Services:		
Mr. Mukerjee (Chief NA, McDermott) @$160/hr.	0	$2,400
Mr. Dixon, (Staff NA, McDermott Offshore) @$50/hr.	$4,000	$7,500
Actual Funds (none)	N/A	N/A
$ VALUE OF SERVICES FROM GOVERNMENT:		
In-Kind Services	N/A	N/A
Actual Funds (none):	N/A	N/A

NUMBER OF SIGNIFICANT CONTACTS:

Industry:

Mr. Mukerjee (McDermott Offshore)

Dr. Kokinias (Exxon PR)

Academic:

Prof. Yeung (University of California at Berkeley)

Prof. Cheung (University of Hong Kong)

Government:

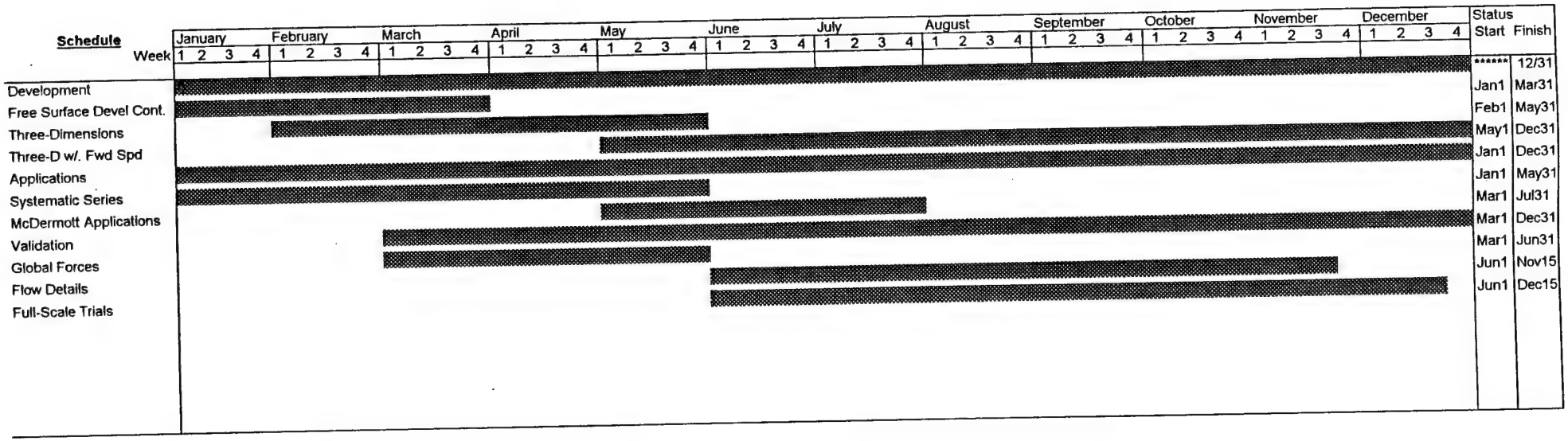
H. Chatterton (NAVSEA)

B. McCrieght (DTRC)

K.6 TIMELINE PROGRESS

The original and second modified timelines are included for reference. The original timeline has been modified to reflect that an additional model test validation is planned.

Improvement of Roll Motion Characteristics



APPENDIX L

EVALUATION OF Cr(VI) EXPOSURE LEVELS IN THE SHIPBUILDING INDUSTRY

GCRMTC PROJECT NO. AMTC96-032A

Principal Investigator:

Bhaskar Kura, Ph.D.
Department of Civil and Environmental Engineering

Additional Investigator:

Charles Null
NAVSEA, SCA 03M2

University of New Orleans
New Orleans, LA 70148

L.1 PROJECT SYNOPSIS

The Occupational Safety and Health Administration (OSHA) is expected to reduce permissible exposure limits (PEL) of Cr(VI) from 100 $\mu g/m^3$ to anywhere between 5 and 0.5 $\mu g/m^3$. A study conducted by the Navy/Industry Task Group organized by NAVSEA revealed that the impact of the proposed regulations on the shipbuilding industry is significant. The study concluded that the cost of compliance by Navy facilities is as much as $46 million/year, in addition to a one-time cost of about $22 million. Also, the task group estimated that the cost of compliance by private shipyards is $37 million/year, in addition to a one-time cost of $9 million. The task group submitted the study results to OSHA for its consideration while developing the standards.

The main objective of this project is to support the Navy/Industry Task Group activities by:

1. Generating additional exposure data for selected shipyard welding processes, and
2. Evaluating techno-economic feasibility for compliance.

The project duration is two years. Project activities include:

1. Identification of welding processes for assessment of worker exposure,
2. Identification for processes, monitoring, and analysis,
3. Sample collection,
4. Analysis of airborne particulate samples for Cr(VI) using OSHA's method 215, and
5. Evaluation of techno-economic procedures for complying with OSHA's standards.

The first four tasks will be completed during the first year. Techno-economic evaluation will be done in the second year.

L.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED - YEAR 1:	$92,347
FUNDS REMAINING:	$3,497

L.3 ACCOMPLISHMENTS DURING CURRENT QUARTER

The original tasks and the status of each task are discussed below.

TASK 1: IDENTIFICATION OF WELDING PROCESSES FOR ASSESSMENT OF WORKER EXPOSURE

This activity was completed in the second quarter.

TASK 2: IDENTIFICATION OF SUPPORT ON PROCESSES, MONITORING, AND ANALYSIS

1. Discussions were held with Newport News Shipbuilding to identify the materials required for conducting laboratory tests on flux cored arc welding (FCAW) on DH-36 base metal.

2. A similar sampling process and sample analysis as used for gas metal arc welding (GMAW) and FCAW on HY-100 were identified for use with FCAW on DH-36 base metal.

   Note: GMAW and FCAW on HY-100 were evaluated last quarter. FCAW on DH-36 is an additional activity which was not originally included in the project, but was approved in the current quarter.

3. Quality assurance and quality control (QA/QC) procedures were laid out for the sample collection and analysis for FCAW on DH-36 steel.

TASK 3: SAMPLING AIRBORNE EMISSIONS OF CR(VI)

The sampling of airborne emissions was completed for FCAW on DH-36 base metal.

Seven samples were taken to evaluate the direct exposure to the welder. Also, an additional seven area samples were collected for each welding activity to evaluate the indirect exposure to other workers.

TASK 4: ANALYSIS OF AIRBORNE PARTICULATES FOR CR(VI)

Samples collected for FCAW on DH-36 are currently being analyzed. The results will be available by the end of January 1997.

It may be noted that the results of GMAW and FCAW on HY-100 steel were included in the report of the previous quarter and, hence, are not repeated here.

ADDITIONAL PROJECT-RELATED TASKS COMPLETED DURING CURRENT QUARTER

1. A contribution of $ 4,000 was secured from NAVSEA to evaluate FCAW on DH-36 (ABS grade) steel.

2. A technical paper, titled "Hexavalent Chromium Exposure Levels Resulting from Shipyard Welding," was completed and submitted for presentation at the 1997 Ship Production Symposium to be held in New Orleans in April 1997. The Society of Naval Architects and Marine Engineers organizes the symposium.

3. The draft of the interim report for the first year is 60% completed.

4. Discussions were held with Mr. Ren Brenna of the Navy Surface Warfare Center - Carderock Division (NSWCCD). NSWCCD is involved in evaluating selected shipyard processes for Cr(VI) exposure and will be interested in collaborating with UNO in analyzing their samples using UNO's ion chromatograph (IC) available in the Department of Civil and Environmental Engineering.

5. Discussions were also held with Ms. Kathleen Paulson of Naval Facilities Engineering Service Center (NFESC) regarding the future activities concerning the evaluation of Cr(VI) exposures and engineering controls, as well as possible collaboration. Ms. Paulson indicated that NFESC will buy equipment to evaluate the effectiveness of engineering controls to minimize Cr(VI) exposure. Selected Navy or commercial shipyards will evaluate the equipment. The GCRMTC is investigating the possibility of collaborating with NFESC and the shipyards involved in the study.

PRELIMINARY CONCLUSIONS

1. Based on the results obtained for GMAW and FCAW on HY-100 steel, it is concluded that these processes will not be critical for Cr(VI) PEL's of 5.0 $\mu g/m^3$ and 10 $\mu g/m^3$.

2. If OSHA proposes a PEL of lower than 5.0 $\mu g/m^3$ for Cr(VI), the above welding processes on HY-100 can become critical.

3. If OSHA proposes a PEL of 0.5 $\mu g/m^3$ for Cr(VI), GMAW and FCAW on HY-100 will become critical and will need effective engineering controls to minimize worker exposure as well as secondary exposure of personnel in surrounding areas.

PRELIMINARY RECOMMENDATIONS

1. Engineering controls should be investigated that are most effective in terms of technical and economic feasibility for GMAW and FCAW on HY-100 to reduce Cr(VI) exposures below an action level of 0.25 $\mu g/m^3$ for arc times of 4 hours and higher during an 8 hour work period (with an anticipation that OSHA will propose a PEL of 0.50 $\mu g/m^3$ for Cr(VI)).

2. While other Navy and commercial shipyards, and some organizations such as American Welding Society/Edison Welding Institute, will be evaluating various shipyard processes for Cr(VI) exposure, it is recommended that Cr(VI) exposure resulting from GMAW and FCAW on high chrome alloys be investigated.

3. For second year studies, it is recommended that the critical welding processes such as shielded metal arc welding (SMAW) and critical materials such as high chrome alloys be investigated for Cr(VI) exposure levels as well as for engineering controls.

L.4 PROPOSED ACTIVITIES FOR NEXT QUARTER

1. Complete the draft of the interim report for the first year for submission to GCRMTC.

2. Consult NAVSEA and other Navy/Industry Task Group members regarding the selection of specific welding methods and materials for evaluating engineering controls.

3. Review the possible industry collaborators for second year activities.

4. Visit NSWCCD and NFESC to discuss in detail collaborative activities and formalize an understanding.

5. Plan and begin the evaluation process, if possible, through field studies with the help of the industry collaborator.

L.5 COLLABORATIVE EFFORTS

	CURRENT QTR.	YTD
$ VALUE OF SERVICES FROM INDUSTRY:		
In-Kind Services:	2,000[a]	8,000
Actual Funds:		
$ VALUE OF SERVICES FROM GOVERNMENT:		
In-Kind Services:	1,000[b]	4,000
Actual Funds:	4,000[c]	4,000
NUMBER OF SIGNIFICANT CONTACTS:		
Industry:	0	2
Academic:	0	0
Government:	1[d]	3

COMMENTS:

[a]Cost of man-hours by the staff of Newport News Shipbuilding Company. Estimated at a total of 20 hours during current quarter, using an hourly rate of $100.

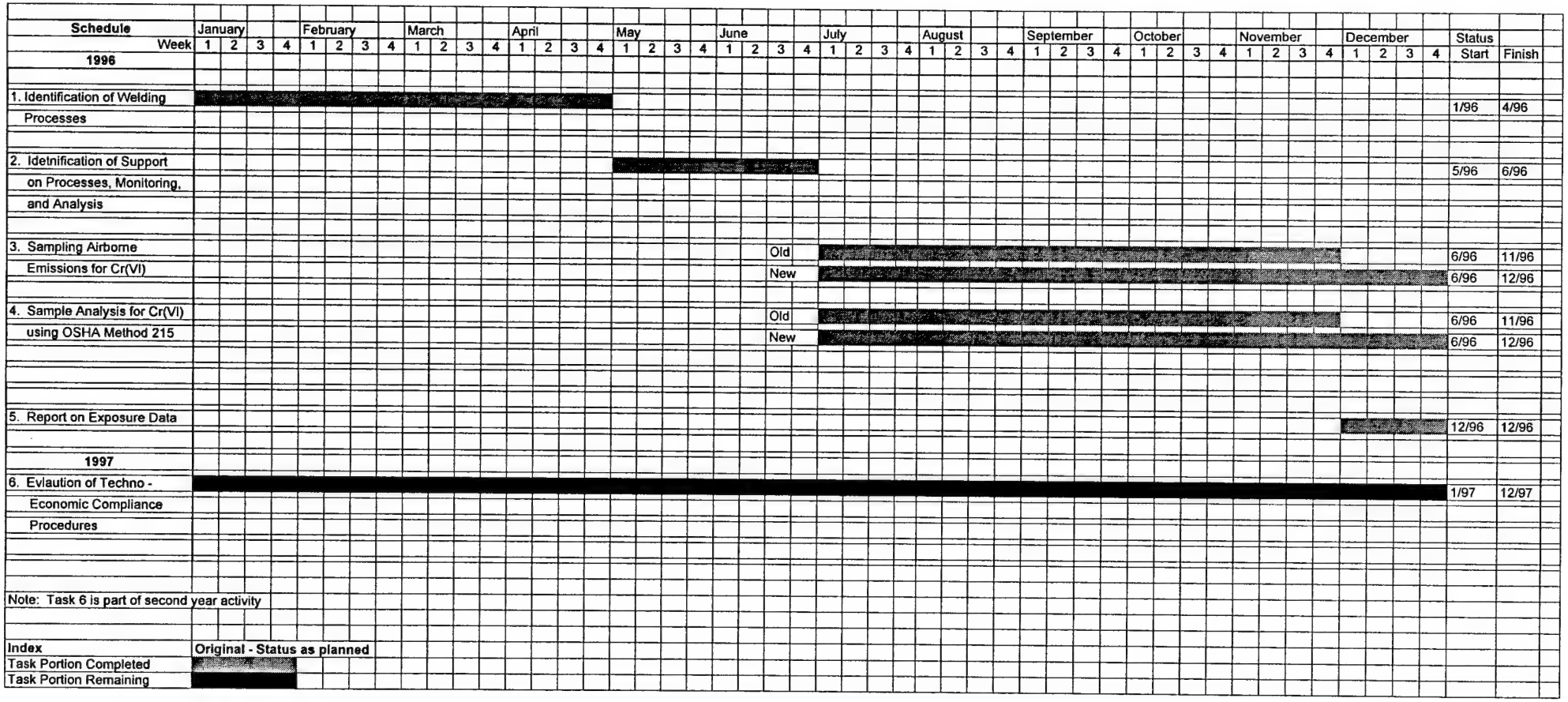
[b]Cost of man-hours by the Co-P.I. not charged to the project. Estimated at a total of 10 hours during this quarter, using an hourly rate of $100.

[c]NAVSEA contributed a total of $4,000 for investigating Cr(VI) exposure resulting from FCAW on DH-36 Steel. NAVSEA paid the money directly to Newport News Shipbuilding Company, which is the GCRMTC's industry collaborator on this project.

[d]A significant Government contact made this quarter was:

Mr. Ren Brenna
Navy Surface Warfare Center
Carderock Division

Evaluation of Cr(VI) Exposure Levels in the Shipbuilding Industry



APPENDIX M

INTEGRATING FIRE-TOLERANT DESIGN AND FABRICATION OF COMPOSITE SHIP STRUCTURES

GCRMTC PROJECT NO. AMTC96-033A

Principal Investigator:

David Hui, Ph.D.
Department of Mechanical Engineering

Additional Researchers:

Usman Sorathia
U.S. Naval Surface Warfare Center, Annapolis, MD

Satya Sastri, Ph.D.
Teddy Keller, Ph.D.
Naval Research Laboratory

Piyush Dutta, Ph.D.
U.S. Army Cold Regions Research and Engineering Laboratory

Arnold Mayer, Ph.D.
Wright Patterson Air Force Base, OH

University of New Orleans
New Orleans, LA 70148

M.1 PROJECT SYNOPSIS

The application of composite materials in commercial and U. S. Navy ships offers the potential for improved corrosion resistance, reduced life cycle costs, reduced radiated noise, and increased warfare survivability. To quantify these benefits, the U.S. Navy has designed and built prototype structures and has shown that they successfully meet shock and fire resistance requirements.

The proposed work deals with the integration, design, and fabrication of composite materials under flammability conditions. The purpose is to ensure that adequate structural strength is present after the material has been exposed to high temperature flames. The proposed work also deals with the development of an analytical technique involving creep deflection of beams made of composite materials. The analytical technique can predict the composite material fire tolerance. Experiments involving specimens tested in the Material Testing System (MTS) machine with an environmental chamber will be conducted to validate the theoretical creep bending model.

M.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED	$150,000
FUNDS REMAINING	$100,672

M.3 ACCOMPLISHMENTS DURING CURRENT PERIOD

TASK 1: THEORETICAL MODELING OF CREEP BEHAVIOR OF COMPOSITES

The project started July 1, 1996, for a duration of 24 months. The creep behavior of composite beams under three-point bending were determined using the Findley equation.

TASK 2: LITERATURE SEARCH ON CREEP BEHAVIOR OF COMPOSITES

This task has been completed. Several very relevant publications have been identified.

In addition to the relevant papers reported in the last quarterly report, more literature concerning viscoelastic response and modeling of polymeric composite materials, including Xiao et al. (1994), Yen and Williamson (1990), Hiel et al. (1984), and Lou and Schapery (1971) were found. Most of their modeling was based on isothermal uniaxial creep and creep-recovery tests. Investigations on viscoelastic flexural behavior of polymeric composite materials are rare. Creep behavior will be investigated for three-point bending tests of polymeric composites. The creep component for Findley's equation is found by fitting data of flexural creep tests. It is assumed to be independent of both stress and temperature.

TASK 3: IDENTIFICATION OF CRITICAL PARAMETERS FOR CREEP OF COMPOSITES

This task started September 1, 1996, for a duration of 6 months. Creep behavior for polymeric composites depends on ultimate tensile stress, Young's modulus (E), geometry (or moment of inertia (I)), and the support condition. Several references show that the ultimate tensile stress (defined as the maximum stress in the stress versus strain curve) and Young's modulus decrease with increasing temperature. Moreover, char may form outside the surface of composites under burning. Hence, the effective thickness and also the second moment of inertia of the composites are reduced.

Therefore, three-point bending tests are proposed to investigate the degradation of composite beams under high temperature. By using a three-point bending test, it is convenient to find the flexural rigidity (product of Young's modulus E and moment of inertia I) of the composite beam. However, the degradation of Young's modulus as a function of increasing temperature must be determined by independent tests. Hence, uniaxial tensile creep tests on the composites are also done to find the variation of Young's modulus individually at different high temperatures

TASK 4: SAMPLE EXPERIMENTAL MODELING

This task started September 1, 1996, for a duration of 6 months. The results for the current quarter are as follows.

Task 4A: Sample Composite Plates Preparation

The glass vinyl ester samples were manufactured at the Naval Surface Warfare Center, with the size of the square plate being 3 inches by 3 inches.

Task 4B: Test Support Design

The support conditions have been designed to allow the cases of both a no mechanical load and a static load applied on the center of a specimen simply supported in a test chamber.

Task 4C: Research Results

Typical results for time-dependent modulus loss for vinyl ester composite near the glass transition temperature were obtained from Usman Sorathia at the U. S. Naval Surface Warfare Center.

TASK 5: THERMAL CONDUCTIVITY OF COMPOSITES

This task started May 1, 1996, for a duration of 12 months. Co-investigators are Kim-Ho Ip and Piyush Dutta (U.S. Army Cold Regions Laboratory, Hanover, NH).

The aim of the project is to predict and test the thermal conductivity of fiber-reinforced composite laminates. Fiber-reinforced composite laminates are widely used in aerospace structures due to their ease of manufacturing, light weight, and tailorable properties. However, it is well known that temperature has an undesirable effect on the mechanical properties of these materials. To understand the thermoelastic behavior of composites in low and high temperature environments, it is necessary to determine their thermal conductivities.

Two independent thermal conductivities were investigated, one longitudinal and one transverse, which were adequate to describe the heat conduction behavior of unidirectional composites. The longitudinal conductivity of a lamina was predicted satisfactorily by the rule of mixtures. Expressions for the transverse conductivity of a lamina are also available. These models include simple models using combinations of thermal resistance, bounding principles, and mechanical analogies. A comprehensive report is being prepared on this topic.

TASK 6: DATA COLLECTION FROM EXISTING EXPERIMENTAL RESULTS

This task started October 1, 1996, for a duration of 6 months. A series of three-point bending creep tests under different high temperatures are being done on the glass vinyl ester. The tests are being carried out by using the MTS machine at the Material Science Laboratory of the University of New Orleans.

Based on ASTM D790, the size of the glass vinyl ester specimen is 7.25 inches by 1 inch by 3/32 inch. It is simply supported on a span of 45/8 inches. The tests are performed at 60°C, 70°C, 80°C, 90°C, 100°C, 110°C, and 120°C. Different maximum stresses, including 10 MPa, 30 MPa, 50 MPa, 70 MPa, and 90 MPa, are applied to the specimens.

Maximum strains at the mid-span are calculated based on equation (2) in ASTM D790. The strains are plotted against time at different temperatures and stresses. Fitting these results by using Findley's equation, the creep parameters of the specimen can be obtained. Moreover, the degradation of rigidity of the specimen can be determined by simple beam theory.

Uniaxial tensile tests under different temperatures and stresses are also done on the specimen to determine the degradation of Young's modulus individually.

M.4 PROPOSED ACTIVITIES NEXT QUARTER

TASK 7: SCALING EFFECTS

This task will start January 1, 1997, for a duration of 12 months. The Material Testing Machine will be used to conduct creep bending experiments on beams under high temperature to simulate flammability conditions. The three- or four-point bending fixture is being built and the creep experiments will be conducted in the fall of 1997. This procedure will examine whether there are any effects on the creep behavior of beams because of size. The sample size is typically 3 inches long; one would like to test a sample size beam approximately 12-inches long. This would enable one to predict whether there are any scale effects in the eventual quarter size creep test of shipboard structures under flammability conditions.

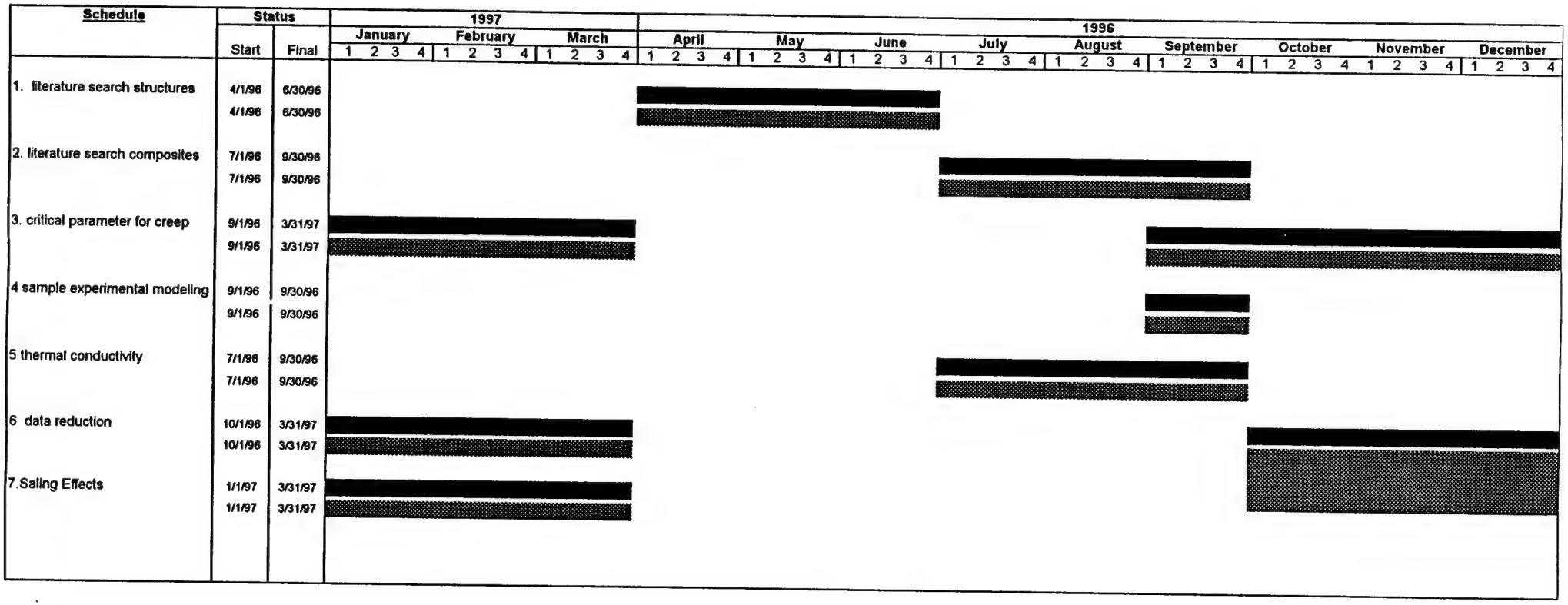
TASK 8: SCANNING ELECTRON MICROSCOPE EXAMINATION ON FIRE DAMAGED COMPOSITES

This task will start April 1, 1997, for a duration of 6 months. The Scanning Electron Microscope will be used to study matrix yielding behavior and fiber pullout and fiber breakage of beams subjected to three or four point bending. Thus, both top fiber (compression) and bottom fiber (tension) failure will be investigated. It is expected that as the temperature and duration of fire are increased, the matrix softening effects will become pronounced. Thus, the creep behavior will become more pronounced at high temperatures. It is expected that the matrix will dominate creep behavior since it has a higher thermal coefficient of expansion.

M.5 COLLABORATIVE EFFORTS

	CURRENT QTR.	YTD
$ VALUE OF SERVICES FROM INDUSTRY:		
In-Kind Services:		
Aram Mekjian (British Petroleum Chemicals, NJ) 10 hrs. @$50/hr.		$1,000
Actual Funds:		
Supply or resins for making the samples.		1,000
$ VALUE OF SERVICES FROM GOVERNMENT:		
In-Kind Services:		
Usman Sorathia (U.S. Naval Surface Warfare Center, Annapolis, MD), 40 hrs. @$50/hr.	$2,000	4,800
Travel to New Orleans (July 21 - 26, 1996)		1,000
Satya Sastri (U. S. Naval Research Laboratory, Washington, D. C.), 10 hrs. @$50/hr.	500	500
Dr. Piyush Dutta (U. S. Army Cold Regions Research and Engineering Laboratory, Hanover, NH), 20 hrs. @$50/hr.	1,000	6,000
Dr. C. H. Hsueh (Oak Ridge National Laboratory, Oak Ridge, TN), 10 hrs. @$50/hr.	500	2,000
Dr. Arnold Mayer (Wright Patterson Air Force Base, OH), 10 hrs. @$50/hr.	500	1,000
$ VALUE OF SERVICES FROM ACADEMIC:		
In-Kind Services:		
Dr. Su-Seng Pang (Louisiana State University) 5 hrs. @$50/hr.	250	500
Dr. Chihdar Yang (Louisiana State University) 5 hrs. @$50/hr.	250	500
	$5,000	$18,300

Integrating Fire-Tolerant Design and Fabrication of Composite Ship Structures



APPENDIX N

SHOCK REDUCTION OF PLANING BOATS

GCRMTC PROJECT NO. AMTC96-041A

Principal Investigator:

William S. Vorus, Ph.D.
School of Naval Architecture and Marine Engineering

Principal Industry Collaborator:
Anil Raj
Halter Marine, Inc.,
Gulfport, MS

Participant:
Ronald Peterson, Ph.D.
Naval Surface Warfare Center Coastal Systems Station
Panama City, FL

University of New Orleans
New Orleans, LA 70148

N.1 PROJECT SYNOPSIS

The problem addressed is the operational constraints imposed on planing craft by wave impact acceleration. From strength and operational points of view, planing craft can generally operate in a seaway at higher speeds than are commonly practiced. The speed reducing limitation is imposed by the inability of human occupants to withstand the shock associated with pounding through waves.

The objective of this research is to develop design technology for reducing the impact shock severity aboard planing craft at the occupant level and, thereby, making possible the expansion of boat operating-speed versus wave-height envelopes.

The approach being followed is first theoretical hydro-mechanical analysis of possible innovations. This will be followed by experimental confirmation of the effectiveness of candidate approaches, culminating in prototype development and sea testing.

N.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED:	$147,714
FUNDS REMAINING:	$81,445

N.3 ACCOMPLISHMENTS DURING THIS QUARTER

The timeline from the third quarter 1996 report showing the projected schedule by task for 1996 is included as the last page of this appendix. The lightened bars on the timeline for each task represent the actual schedule achieved for the year on the basis of accomplishments in the fourth quarter. As can be seen, the third quarter schedule was maintained in completing the original 1996 work objectives on schedule.

Of the six first-year tasks, only the sixth was scheduled to be carried over to 1997. Tasks 1 through 5 were all completed by the end of the third quarter, as discussed in last quarter's report. The fourth quarter work concentrated on Task 6, the progress of which is described as follows.

TASK 6: PERFORM COMPARATIVE EVALUATION USING LEVEL II ANALYSIS

Task 6 is to establish the viability of a planing boat shock reduction concept for further detailed development leading to prototype implementation. The concept under study is compliant planing surfaces. It has been established that the magnitude of impact forces (such as would occur at high speed in waves or in drop tests) is sensitive to small temporal changes in planing surface geometry.

The temporal surface change characteristic currently being tested to establish the concept is the simple one-degree-of-freedom open-and-closure of the hull deadrise angle (flapping), as would be effected through a hinge along the keel (see the third quarter report).

In the third quarter 1996 report, curves were given of calculated drop-test impact acceleration (or deceleration), versus time, of a hinged 15-degree deadrise cylinder. In these calculations, the deadrise angle distribution, $\beta(t)$, was specified as a variation between 15 and 20 degrees in a trial and error process to minimize the maximum impact acceleration. This exercise was less than effective because of the lack of guidance available for selecting the beta-time distributions, and the sensitivity that was demonstrated.

A different approach was taken in the fourth quarter work. Rather than try to specify the $\beta(t)$ distribution directly, the nonlinear springs and dashpots were placed between the hull sides and base, as shown on Figure 2 of the third quarter report. The stiffness, k(t), and damping, c(t), element characteristics were then varied to minimize impact acceleration. It was expected that by coupling the $\beta(t)$ distribution to the impact force distribution through the stiffness and damping elements, partial self-determination of effective deadrise distributions would be achieved. The result, for essentially the same case demonstrated on Figure 4 of the third quarter report, is shown on Figure 1, below. C_w and G are the cylinder nondimensional weight ($W/\rho g Z_{ch}^3$) and nondimensional gravity (gZ_{ch}/V_0^2), respectively. The nondimensional gravity has been increased from 0.1 to 0.25 from the third quarter report. This difference is not important, as the acceleration in g's affects only the hydrostatic component of the impact force, which is negligible in the impact acceleration in the time range of interest. It is noteworthy, however, that $\dot{V}(\tau)/G$ is the acceleration in g's. Thus, the maximum impact acceleration shown on Figure 1 is approximately 16.8g's, corresponding to the 15-degree contour at $\tau = 0.06$. For a test section with a beam of , for example, 6 feet, working back through the nondimensionalization gives a time, t, at the 16.8g peak acceleration, corresponding to $\tau = 0.06$, of slightly less than a hundredth of a second.

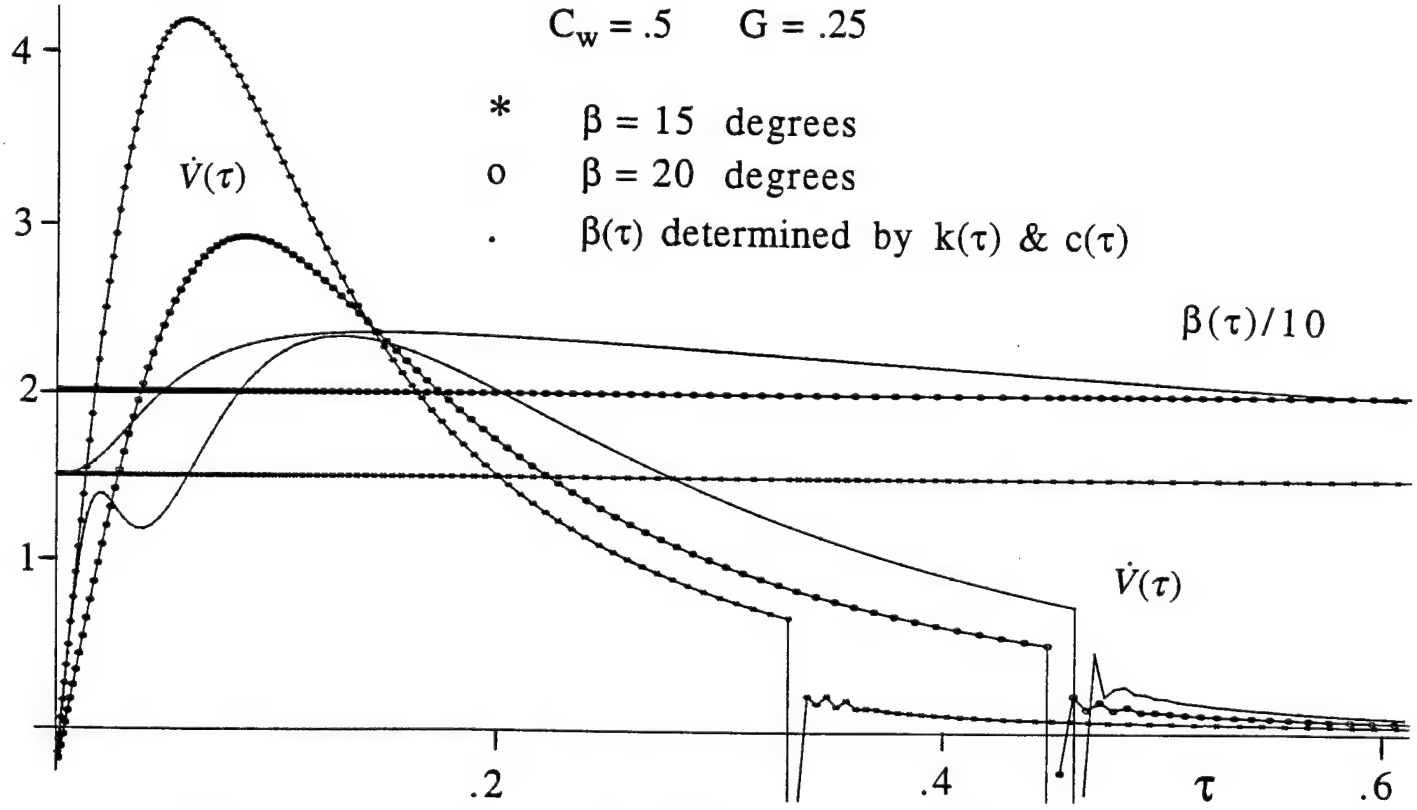


Figure 1. Predicted Shock Acceleration with Passive Control of Deadrise Angle Variation

The stiffness, k(τ), and damping, c(τ), distributions used for computing the β-variable curve of Figure 1 are given on Figure 2. The linear relationship of the impact force, $C_F(t)$, to β and dβ/dt via the stiffness and damping distributions is indicated. The constants in the k and c functions, which are also shown on Figure 2, were selected manually by trial and error to give large impact acceleration reductions with small variations in deadrise angle.

$$C_F(\tau) = k(\tau)\left[\beta(\tau) - \beta_0\right] + c(\tau)\dot{\beta}(\tau)$$

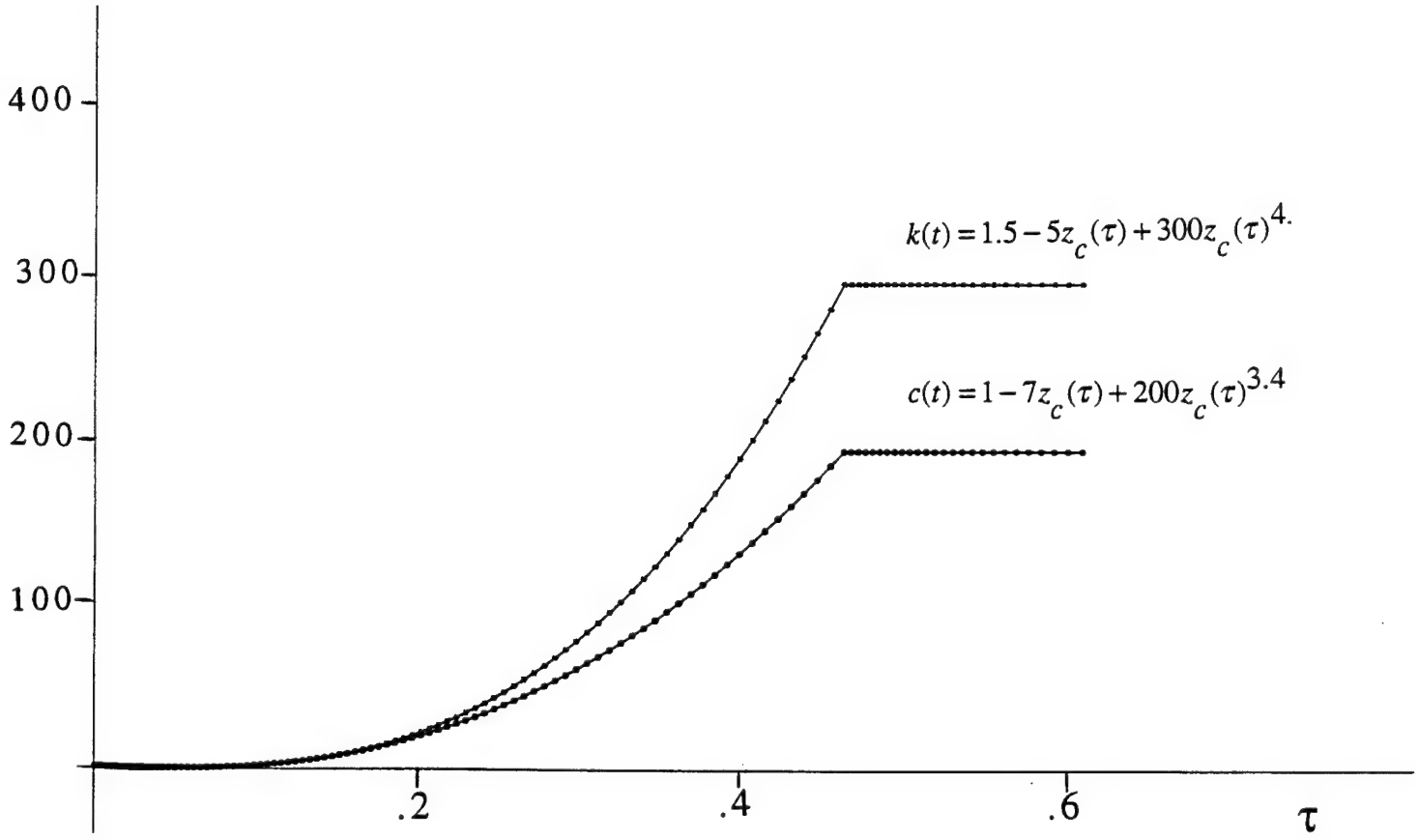


Figure 2. Stiffness and Damping Characteristics of Deadrise Control

A primary effect of the β-variation, in addition to reducing the acceleration maxima, is to spread the acceleration out. This is as demonstrated by the calculation of Figures 1 and 2. At chine-wetting, which occurs at approximately τ = 3.4 for the 15-degree cylinder and at approximately τ = 4.5 for the other two cases, the impact acceleration drops to negligible levels. Furthermore, it must be considered that in actual sea-wave impact versus drop tests, the impact can occur only for a time period as dictated by the wave length characteristics. Therefore, spreading the impact and shifting its peak outward in time, in consideration of chine and sea-wave geometry, can only benefit the degree of shock reduction achieved.

At this point, the use of compliant surfaces to produce cancellation in the impact hydrodynamics of planing craft continues to appear as a promising concept for seaway impact shock reduction.

N.4 PROPOSED ACTIVITIES NEXT QUARTER

A second year concept proposal to continue this work was presented to the GIAB at the December 12, 1996, meeting. On the basis of the outcome of that meeting, a second year project proposal is in preparation. The plans for the second year, including a new timeline, will be developed in detail in that proposal. Meetings will be held in mid-January with the co-PI at the University of Michigan and the collaborator at the Naval Surface Warfare Center Coastal Systems Station to solidify the direction of the second-year work. It is anticipated that hardware implementation and impact testing will be conducted.

N.5 COLLABORATIVE EFFORTS

NSWC Coastal Systems Station (CSS) has been funded by the Office of Naval Research (ONR) to specifically support our work on the GCRMTC project. CSS will design and construct the experimental apparatus needed to confirm the impact predictive methods and will conduct the tests. To date, $10,000 has been spent by CSS (in the fourth quarter 1996) in designing the test gear and planning the tests cooperatively with us.

	CURRENT QTR.	YTD
$ VALUE OF SERVICES FROM INDUSTRY:		
In-Kind Services:		0
Actual Funds:		0
$ VALUE OF SERVICES FROM GOVERNMENT:		
In-Kind Services:	$10,000	$10,000
Actual Funds:		0

NUMBER OF SIGNIFICANT CONTACTS:

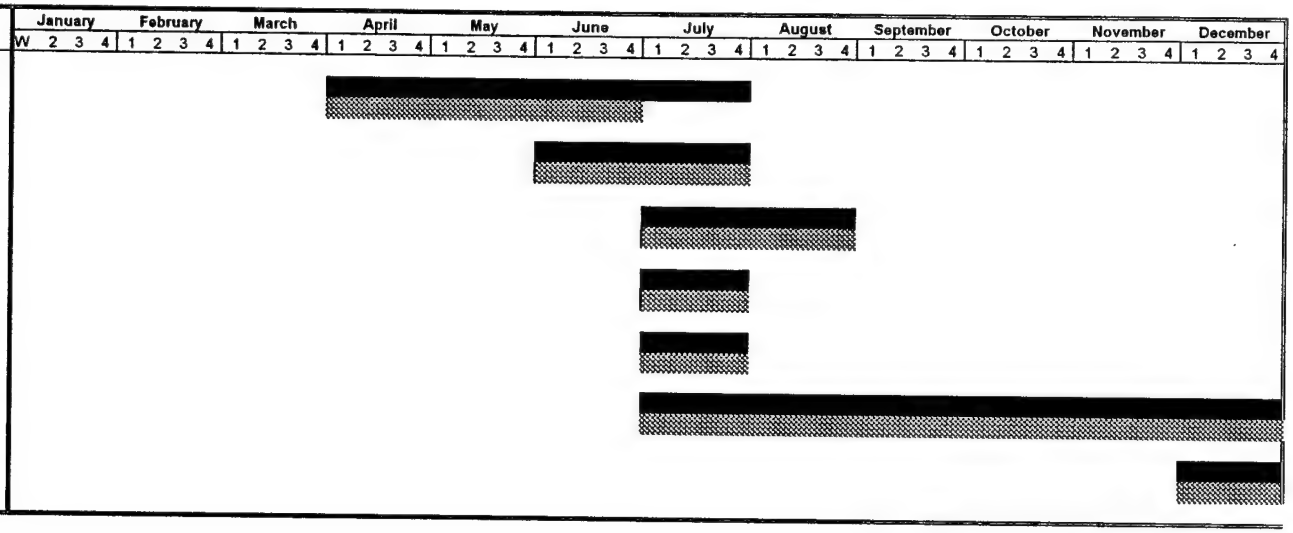
Industry: Mr. Anil Raj, Halter Marine

Academic: Professor John Breslin, Stevens Institute (Ret.)

Government: Dr. Ronald Peterson, NSWC-CCS

Shock Reduction of Planing Boats

Schedule	Status Start	Status Finish
Expand Level I Model to Include Hull Stakes	4/1/96	7/31/96
Verify by Comparison with Drop Test Data	6/1/96	7/31/96
Expand Level II Model for Sprung Subsystems (Partially Complete)	7/1/96	8/31/96
Select Candidate Concepts for 1st Level Analysis	7/1/96	7/31/96
Select Base Hull for Comparison	12/1/95	12/31/96
Perform Comparative Evaluation Using Level II Analysis	11/1/95	12/31/96
Select Competitive Concepts and Configuration to Continue	4/12/96	2/1/97



APPENDIX O

SHIP PROPELLER THRUST AND TORQUE MEASUREMENT

GCRMTC PROJECT NO. AMTC96-053A

Principal Researcher:

Paul M. Chirlian, Eng. Sc.D., P.E.
Department of Electrical Engineering

Additional Researchers:

Russell E. Trahan, Jr., Ph.D.
Department of Electrical Engineering

Yiangyang Yang, Ph.D.
Department of Electrical Engineering

William S. Vorus, Ph.D.
School of Naval Architecture and Marine Engineering

University of New Orleans
New Orleans, LA 70148

O.1 PROJECT SYNOPSIS

This project is to provide instrumentation, based on fiber optic methods, to measure ship shaft thrust and torque accurately. Optical methods are free from electrical interference and can be extremely accurate. Thrust will be determined by measuring the deflection (compression) of a relatively short section of the propeller shaft. This deflection will be measured by clamping one end of a one-meter collar to the shaft. The relative linear displacement of the free end of the collar and the shaft directly under it will be compared using optical techniques. At the present time, it is proposed to use Moiré fringe patterns to very accurately measure the deflection of the shaft. Torque will be measured using a similar collar clamped at one end. The relative rotational deflection of the free end of the collar and the free end of the shaft will be determined. The torque meter will be evolved from a successful torque meter that has been developed jointly by the University of New Orleans and Omni Technologies, Inc. This evolution, which will probably use Moiré patterns, should allow the same torque and thrust measurements to be performed using much of the same hardware.

O.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED:	$250,389
FUNDS REMAINING:	$194,061

O.3 ACCOMPLISHMENTS DURING CURRENT QUARTER

Much of the equipment that had been ordered was received. A list of the equipment received is included in this report. The study of Moiré fringe pattern physics and measurements has been completed and a proposed method for the measurement of shaft compression has been established. The ordering of the tasks has been modified somewhat because the more sensitive thrust measurement technique will affect the choice of the torque measurement procedure. Thus, more work has been done on Task 3 than on Task 2. As noted, if possible, the thrust and torque measurement procedures should make use of the same collar and optics.

TASK 1: A STATE OF THE ART SURVEY

The study of Moiré fringe patterns has been essentially completed. An update of the literature search was substantially completed. The patent search is not yet complete.

The following hardware has been received for the project:

- SMA adapter,
- Optical supplies,
- Micrometer,
- Glass scales,
- ST fiber optic coupler,
- DAQ boards and cables,
- Breadboards,

- Support posts,
- Laser mount assembly,
- Platform,
- Bare fiber holder,
- Screw kit.

TASK 2: DEVELOPMENT OF TORQUE METER SUITABLE FOR USE ABOARD COMMERCIAL SHIPS

As noted, procedures used in Task 3 may be applied to Task 2. For this reason, more initial time will be devoted to Task 3.

Preliminary considerations of the modification of the torque meter to utilize Moiré patterns have been initiated.

TASK 3: MEASUREMENT OF SHIP PROPELLER THRUST

Much of the basic theoretical work involved with the Moiré pattern measurement technique has been completed.

There are several approaches to using Moiré patterns to detect movement (compression) between two points. They are:

1. Optical heterodyne method.

2. Electric heterodyne method.

Currently, we believe that (3) a heterodyne readout technique is the best method to obtain the required data. The optical heterodyne method involves the fundamental Moiré patterns. Consider two gratings with slightly different pitches positioned one below the other. Assume that the intensity of the two gratings varies sinusoidally as represented by the following equations:

$$I_1 = A \sin(k_1 x + \phi) \qquad 1^{st} \text{ grating} \qquad (1)$$

$$I_2 = B \sin(k_2 x + \varphi) \qquad 2^{nd} \text{ grating} \qquad (2)$$

When the two intensities are multiplied together optically (one placed behind the other, both in front of a light source), sum and difference frequencies are produced. The difference frequencies ($k_1 - k_2$) result in the Moiré pattern. Note that k_1 and k_2 are almost equal. The pitch of the first grating is $1/k_1$ while the pitch of the Moiré pattern is $1/(k_1 - k_2)$. Thus, the pitch of the Moiré pattern is much greater than the pitch of the grating. Consider that the second grating is fixed and that the first grating moves. If the relative motion of the second grating is δ/k_1 the motion of the Moiré pattern will be $\delta/(k_1 - k_2)$. Thus, the motion of the Moiré pattern will be many times the motion of the grating. This should allow the displacement to be measured with greater accuracy. A typical example is shown in Figure 1.

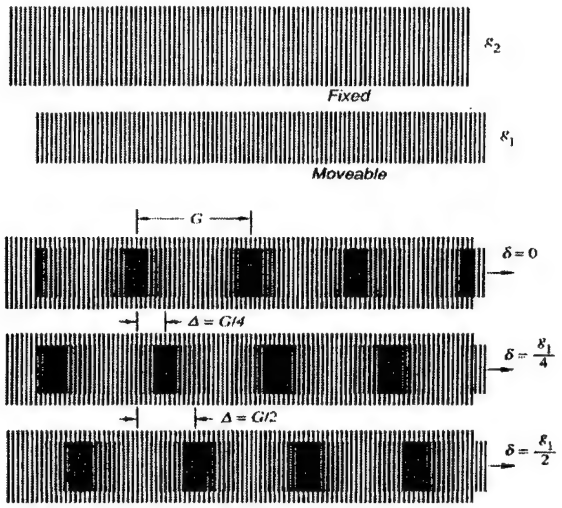


Figure 1. Moiré Patterns

The electric heterodyne method uses gratings of the same frequency. That is, in equations (1) and (2)

$$k_1 = k_2 = k$$

Again, the product I_1I_2 is obtained. Because frequencies are the same, an intensity which varies at 2k and another that is constant are obtained. If the product I_1I_2 is integrated over one period, the result is a term that is equal to:

$$P_1 = KAB \cos(\phi - \varphi) \qquad (3)$$

where K is a constant.

Now consider that a third grating is added to the system. Its intensity is:

$$I_3 = B \cos(k_2x + \varphi) \qquad 3^{rd} \text{ grating} \qquad (4)$$

Multiplying the 1st grating by the 3rd grating and integrating the product I_1I_3 over one period yields:

$$P_2 = KAB \sin(\phi - \varphi) \qquad (5)$$

An absolute phase reference can be obtained by taking the ratio P_2/P_1.

$$P = P_2/P_1 = \tan(\phi - \varphi) \qquad (6)$$

Thus, the displacement of the first grating with respect to the second and third gratings can be obtained as a fraction of the grating pitch. An illustration of this technique is shown in Figure 2.

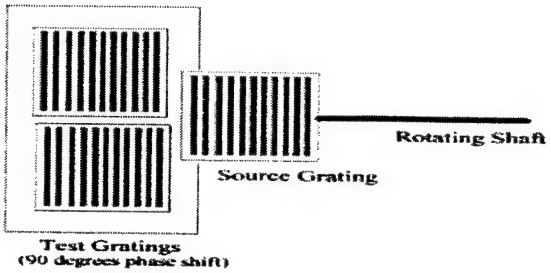


Figure 2. Illustration of Displacement Technique

The product of the source grating intensity and the intensities of each test grating yields the products I_1I_2 and I_1I_3. Simulations of this technique will allow us to test the impact of a number of non-ideal conditions, such as grating imperfections and light divergence on the measurements. Software is being written to implement these simulations. The suggested configuration for the thrust sensor is as shown in Figure 3.

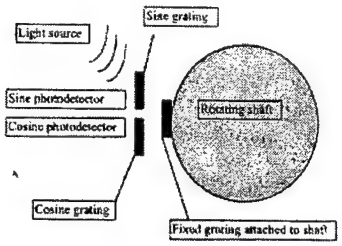


Figure 3. Suggested Configuration for Thrust Sensor

PROPOSED ACTIVITIES NEXT QUARTER

Task 1 activities will be completed. The simulation of the thrust measurement procedure will be completed. If no complications develop, construction of a small scale model will be initiated to validate the procedure. Redesign of the torque meter will be considered in detail once the thrust measurement technique is established.

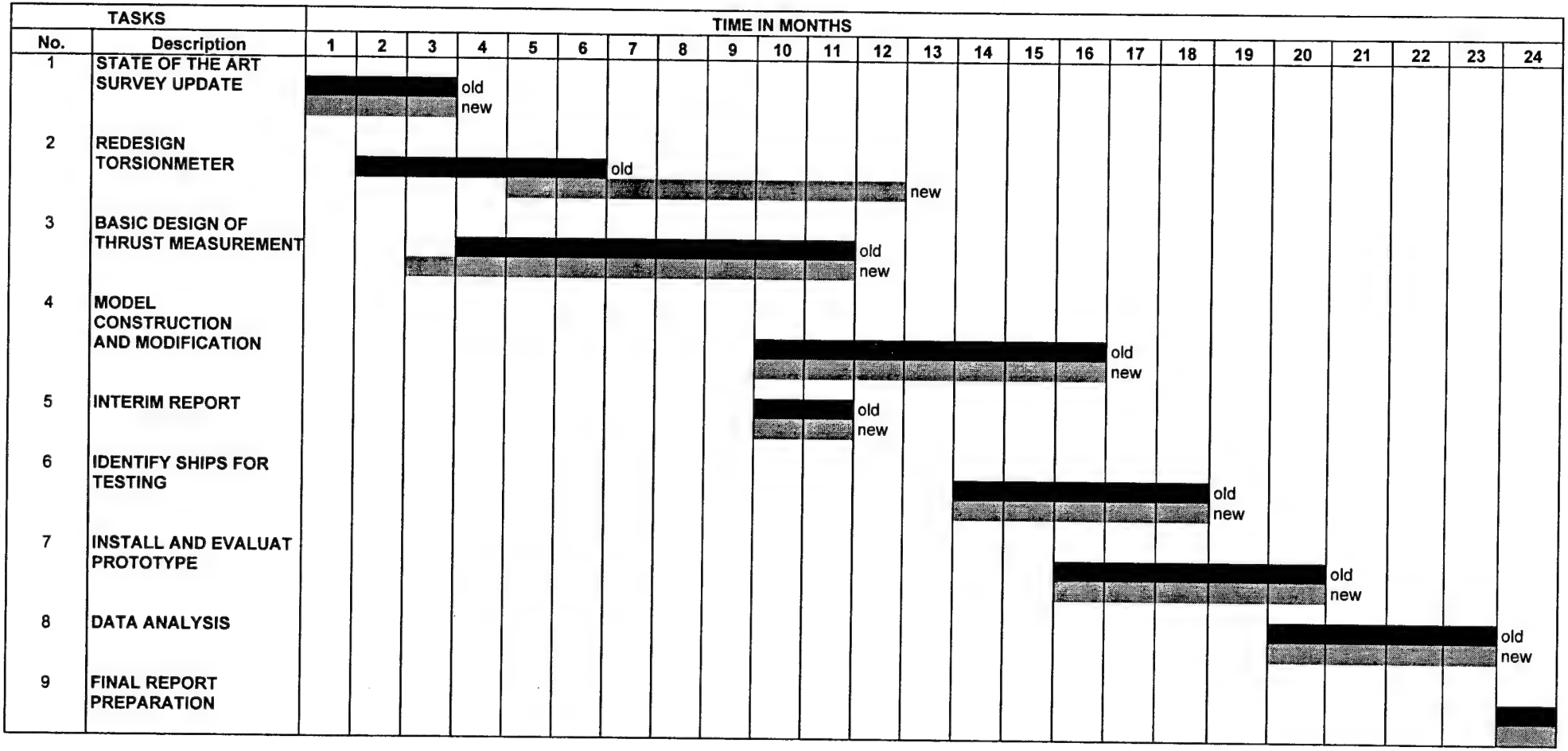
COLLABORATIVE EFFORTS

There have been no collaborative activities this period. When a prototype is developed, collaborative activities with shipyards will be initiated.

COMMENTS:

The Budget Status amounts reflect the budget statement of October 31, 1996. Omni Technologies bills through December 5, 1996 are also included. Orders for equipment and supplies in the amount of $10,222 have been placed and are included. The account will be billed for release time and supplementary salaries, as indicated on the budget on October 31, 1996.

Ship Propeller Thrust and Torque Management



APPENDIX P

COANDA CIRCULATION CONTROL MANEUVERING SYSTEM

GCRMTC PROJECT No. AMTC96-073

Principal Investigator:

Neal A. Brown, Ph.D.
Department of Naval Architecture and Marine Engineering

Co-Principal Investigator:

William S. Vorus, Ph.D.
Department of Naval Architecture and Marine Engineering

University of New Orleans
New Orleans, LA 70148

P.1 PROJECT SYNOPSIS

Tangential water blowing at the specially rounded trailing edge of a hydrofoil is known to produce lift of large magnitude, which is an application of the Coanda phenomenon. Recent tests in a wind tunnel, under U. S. Navy support, demonstrated that differential blowing at the trailing edge of a ring-wing, simulating a propulsor duct, produced large lateral forces which could be useful for low speed maneuvering of ships. Models of Kort-nozzle propulsors and rudders fitted with Coanda trailing edge blowing will be operated in the UNO towing tank where their maneuvering force performance and limitations are to be measured and demonstrated. This is an important step in the commercialization of the technology.

P.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED:	$179,788
ESTIMATED FUNDS REMAINING:	$122,000

P.3 ACCOMPLISHMENTS DURING CURRENT QUARTER

1. Project briefed to SNAME Panel H-8, on 10/02/96,
2. Work authorized on 10/25/96,
3. Underwater motors selected and propellers matched,
4. Quarterly Review meeting with PIC, Bird-Johnson Co., on 11/26/96,
5. Model nozzle construction finalized,
6. AutoCAD-13 ordered and nozzle drawings begun,
7. Motor vendors solicited.

TASK 1: DESIGN, PROCURE MODELS

Most of the above accomplishments pertain to this task.

TASK 2: DESIGN, BUILD DYNAMOMETER

The general configuration was established and the load cells were selected.

TASK 3: PLAN AND TEST PROPULSOR

The preliminary range of variables was established, with the task scheduled to begin in February 1997.

TASK 4: PLAN AND TEST RUDDER

The preliminary range of variables was established, with the task scheduled to begin August 1997.

TASK 5: PLAN AND TEST PROPULSOR WITH RUDDER

The preliminary range of variables was established, with the task scheduled to begin November 1997.

TASK 6: DATA ANALYSIS

The task is scheduled to begin February 1997.

TASK 7: PROGRESS REPORTS

The task begins with this report.

TASK 8: INTERIM REPORTS

The task is scheduled to begin March 1997.

TASK 9: FINAL REPORT, PRESENT AND PUBLISH

The task is scheduled to begin May 1998.

P.4 PROPOSED ACTIVITIES NEXT QUARTER

1. Measure towing carriage vibration and estimate resulting force errors,
2. Design and build isolated sub-carriage, if warranted,
3. Solicit NC machine shops and complete nozzle drawings,
4. Construct nozzle model and obtain model propeller(s),
5. Design and build dynamometer system; fit motor and pump,
6. Code data acquisition system,
7. Begin propulsor performance measurements.

P.5 COLLABORATIVE EFFORTS

	CURRENT QTR.	YTD
$ VALUE OF SERVICES FROM INDUSTRY:		
In-Kind Services:	$1,500	$1,500
Actual Funds:	—	—

$ VALUE OF SERVICES FROM GOVERNMENT:		
In-Kind Services:	$500	$500
Actual Funds:	—	—
NUMBER OF SIGNIFICANT CONTACTS:		
Industry:	2	2
Academic:	—	—
Government:	1	1

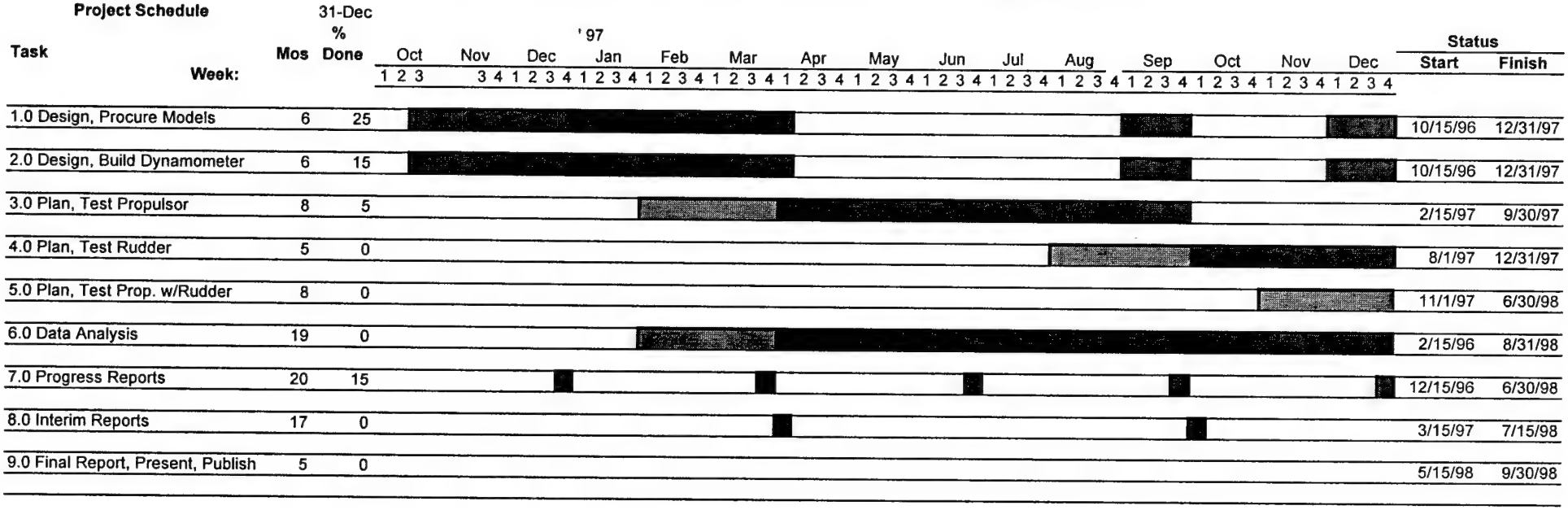
COMMENTS:

1. In-kind support was provided by Bird-Johnson Company, who is the principal industry collaborator (PIC) and by the U. S. Navy, David Taylor Research Center (DTRC), both in the form of meetings and conferences.

2. A brief was presented at the Society of Naval Architects and Marine Engineers (SNAME) Panel H-8 on October 2, 1996. In attendance were DTRC, Bird-Johnson Co., and other industry members.

3. A quarterly review was conducted with the PIC.

Coanda Circulation Control Maneuvering System



APPENDIX Q

ROCKWELL SUBCONTRACT REPORT

UNIVERSITY OF NEW ORLEANS SUBCONTRACT #22

Principal Investigator:

Charles Amaral
Project Manager Maritime
Advanced Information Engineering
Boeing North American, Inc.

University of New Orleans
New Orleans, LA 70148

North American Aircraft Division
Rockwell International Corporation
2600 Westminster Boulevard
PO Box 8644 NA96-1730
Seal Beach, CA 90740-7644

Rockwell Aerospace
North American Aircraft

18 December, 1996

In Reply Refer to:
96L-0101-405CA

Dr. John N. Crisp
Executive Director
Gulf Coast Region Maritime Technology Center
211 Engineering Building
University of New Orleans
New Orleans, LA 70148

Subject: Agreement No. N00014-94-2-0011, UNO Account No. 327-01-5100, sub Contract # 22;
Quarterly Status Report #2, September/October /November 1996

Dr. John Crisp:

INTRODUCTION

On the 6 of December 1996 the North American Aircraft Division of Rockwell International was acquired by *BOEING* Aircraft. North American Aircraft Division along with other former Rockwell Division is a part of a new entity named *BOEING* North American, Inc., a subsidiary of *BOEING* Aircraft. A formal notice will be forthcoming with more details. It is my understanding that North American Aircraft Division will conduct business as usual and all contractual obligations will be transferred to BNA, Inc. The transfer should be transparent to our current obligations. If you have any further question, please, do not hesitate to contact my contracts' person a Mr. Cole Price. Cole can be reached at telephone number (310)797-4604. If I may be of further assistance in this matter I may be reached at (310) 797-4804. Our new motto is "The Best Is Yet To Come."

This is the second quarterly status report for the University of New Orleans agreement no. N00014-94-2-011, UNO Account No. 327-01-5100, Sub Contract #22 for the period 2-27 November 1996. The subcontract is being performed by *BOEING* North American, Inc. in the Seal Beach California facility. *BOEING*'s program manager is Mr. Charles Amaral who has full responsibility for the program's technical content, budget and performance.

This quarterly report covers the progress, problems, and expenditures for the subcontract efforts. Ten tasks have been identified revolving around two build iterations as described in the statement of work. These tasks are aligned with the needs the GCRMTC has identified in the Request for Proposal No. 5676. *BOEING*'s AIE team will use the System Enterprise Methodology (SEM) process to guide the efforts on these tasks.

PARTICIPANT INVOLVEMENT:

B0EING North American, Inc. is now an associate member of the SOCP. This project is an expansion of an effort the SOCP has had in development for over 2 years. Here, *BOEING* personnel need to remain cognizant of the progress of the software projects that the SOCP has in development for the Ship Owners and Operators. Ship Yards will only have access to the RAM Master Base. With this cooperative venture in mind *BOEING* conducted a Workshop #1 for the RAM database expansion team. The meeting was held at the Newport News Shipbuilding facilities located in Newport News, Virginia on the 24/25 of September 1996

There are three Workshops scheduled in the contract. The objective of the first Workshop was to inform the participants of the statement of work. The SEM methodology, and the deliverables required for the GCRMTC. The statement of work describes the tasks required to satisfy the Contract Data Requirements List (CDRLs). The SEM tutorial describes the methodology required in achieving these tasks of this project. The deliverables are the end result of the tasks that will contribute to the recommendations for GCRMTC RAM database.. The feasibility and practicality study for the implementation of a RAM master database will serve as the focal point of the total RAM project.. Additionally, the objectives of this Workshop are to create a Vision Statement for this contract effort. The Vision Statement establishes the goal of the project team and places some measurable values to those objectives. This Vision Statement will drive the development of a unified goal for this project and together with the SOCP's Vision Statement will create an overall vision statement for the entire RAM project. Active participation in the meeting will qualify the participants be assigned tasks. These tasks will need closure during the period prior to the next workshop or at the next workshop.

The main objectives of these workshops are to encourage the participation of the team members. Here, we encourage the participants to take an active part in the tasks. They are physically involved in the development, responsibility, and completion of all the tasks. The scenario is that this is their system. Their inputs, expertise, and participation are essential to the success and usefulness of the RAM project.

Workshop #2 is now in the preparation stages. A joint session will be conducted between the RAM expansion database team and the SOCP. The objective here is to create a harmonious relationship between the two groups that will eventually be involved in the integration of the RAM master database. The joint session exchange of information will involve process flow models, definitions of data elements, information models, and integration methodology. The two organizations will review the Vision Statements that have been created in past workshops. They will develop a Vision Statement for the top level of the RAM project this will help to establish the goal that each organization will try to achieve jointly..

At this workshop #2 a new item will be added to the agenda a New Comers Session will be conducted. There are some participants that could not make the first workshop, however, they indicated that they wanted to participate in the future and they will attend the second workshop. Additionally, it is anticipated, that there will be new participants attending. *BOEING* personnel will be conducting a telephone campaign and sending flyers to encourage more participation from manufacturer and vendors. At an In-Process Review for the Program Manager, Mr. Dale Rome, that was held at the University of New Orleans on the 10th of December 1996 Messrs. Dale Rome, Joel Milano, and Robert Stahl of the Carderock Division, Naval Surface Warfare Center have offered assistance in recruiting more participants for the workshops. This assistance is a welcomed addition to our team efforts.

TECHNICAL RESULTS BY TASK

TASK 1 SEM TRAINING (closed)

The SEM training was given at Newport News Shipbuilding facilities on the 24 and 25 of September 1996. This training involved an overview of the SEM methodology that will be used to perform the tasks of this project. *BOEING*'s Advanced Information Engineering group has developed the Systems Enterprise Methodology (SEM). This unique system of organizing a structured approach to any large system that will require a method of staging a development procedure by modeling techniques to develop a fully developed data model for systems development.

The SEM is being performed by *BOEING* personnel. However, the Resource Experts (representatives from the participating Ship Designers, Ship Yards, Manufactures, and Vendors) have a need to understand this process that will require their input from time to time. As the resource experts they will be required to provide information to the requirements personnel (*BOEING*) to assist in the development of an "AS-IS" Scenario.

On the second day *BOEING* personnel led the group in a workshop environment. The SEM was used to create some Units of Functionality (UoFs), reviewed an AS-IS model and an Application Resource process model that *BOEING* has been developing.

TASK 2 STRATEGIC PLANNING (complete)

Workshop #1 session was held at the Newport News Shipyard facilities in Virginia.

The strategic planning section is the part that determines what task assignments will be done by who and where. Here, task assignments were established for the entire project. Prior to this planning session an overview of the SOCP's DATE, SHIPPER, SPIN, and SHIPS' RAM programs was given in addition to the overview of the SEM methodology.

With this new knowledge the working group is able to proceed with the strategic plan for the entire project. The entire group of attendees worked on the development of a VISION STATEMENT for the project team:

TO - BE VISION STATEMENT

TO PRODUCE THE MOST COMPREHENSIVE TECHNICAL AND HISTORICAL INFORMATION NETWORK TO SUPPORT THE OPTIMIZATION OF MERCHANT SHIPS' RELIABILITY AND COST EFFECTIVENESS FOR ANY STAGE OF THE SHIP LIFE CYCLE PERFORMANCE.

Activities conducted since workshop #1 for task 2 and a result of workshop #1 assignments have been the inputs from team members in reference to the exercise held at the workshop #1 for the Units of Functionality. The results are the establishment of high priority UoFs being incorporated in the SEM format of five statements to establish the Build One requirements' definition.

Feedback comments have been received by *BOEING* SEM personnel from the participating Shipyards. This exchange of information will provide the harmonizing of process flows and the definitions contained therein. This task has been completed and will receive closure at the next workshop #2.

Although, we have closed this task, information will continue to be entered into the As-Is process flow. This is considered a living document and no area will be cast in concrete. The methodology allows for continuous expansion of the system.

TASK 3 BUILD ONE REQUIREMENTS DEFINITION

The *BOEING* team has established a rapport with the user environment. The *BOEING* team has visited various user sites and attended various functions that are pertinent to the objectives of this project. This projects prime objective is to determine how to expand the Ship Operations Cooperative Program's (SOCP) Reliability, Availability, and Maintainability (RAM) projects out to the Ship Designers, Ship

Builders, Vendors, and Manufacturers. A close relationship between this project and the SOCP effort is essential for the successful conclusion and recommendation of this projects goal. The eventual integration of these projects will take place to form a complete life cycle approach for maintaining ships and their component products.

In the requirements gathering analysis it has been established that there are two avenues in developing a RAM database. Under the current conditions: (1) A minimum of commercial ships have been built in the United States in the past several years. The means of collecting data in this time period has been a manual process. Gathering the required information for an automated system will mean analyzing existing data in what ever form and converting it into a digital standard format that can be shared by many. This is referred to as **"LEGACY DATA".** (2) There is in existence today the building of some new ships and the preliminary design of more ships that will be developed in U.S. Shipyards. Here, the opportunity exists to gather information as the ship is in design and under construction in the Shipyard. The ability to gather the actual information in its infancy affords the opportunity to establish a system with **"BASELINE DATA."** This baseline system will expedite the maintenance plan for a new ship and create a means of configuration management of a ship from the "AS-BUILT" stage and throughout the full life cycle. This analyses is essential to establishing a base platform for the requirements' effort.

There is some concern expressed by the user environment, Mr. Sullivan of ARCO, does not want a system that will service their old vessels (or legacy data). They want a system that will be developed using base line data and emerging technology. The rationale here is to stay in tune with the GCRMTC Vision Statement to make the U. S. Shipyards competitive in the World Market, again. Once again, we have established that catching up with other international markets is not sufficient we need to leap-frog existing technology to gain that position in the World market that we once enjoyed.

BOEING personnel have developed a Process Flow Model. This process flow is specific to the machinery and propulsion systems and will concentrate on the RAM of those systems. Initial efforts have been developing a network for communications with the user environment. Site visits, user interviews, user collective data by task assignments and at the conclusion user concurrence are used to establish Units of Functionality (UoF) and functional analysis.

One of the purposes of the Workshop held on the 24 & 25 of September at Newport News Shipyard was the development of the Units of Functionality (UoF). Once the group received the SEM training they now have the ability to establish these UoFs. In addition, the group went on to prioritize the UoFs this prioritization will now lead the Build One Development and other UoFs defined in Build One will then become the foundation for Build #2 module.

TASK 4 BUILD ONE DESIGN THROUGH THE USE OF ENTERPRISE INFORMATION ANALYSIS

As a result of the Workshop held for the Ship Designers, Shipyards, Manufacturers, and Vendors the Build One Design (Task 4) and development of the GCRMTC Enterprise Information Model are currently underway. It is planned to have the GCRMTC staff attend a workshop to be held at *BOEING* facilities in Seal Beach, CA.. At this work shop *BOEING* and GCRMTC staff members will work on an integrated methodology to develop the prototype demonstration platform.

In consideration of lessons learned *BOEING* personnel have discovered the Hardware configuration for the demo platform should be mobile. This allows the entire system to be transported to all workshops including the final demo. *BOEING* will use the Sun system and Oracle software (*BOEING* property)

required to do development work on the Master RAM Database. This action will increase the efficiency of the development system and bring cost savings to the project as well.

TASK 5 BUILD ONE DEVELOPMENT

In TASK 5 the requirements gathering has been well underway and in some areas is complete. However, the core hardware and software required to develop the RAM database prototype has been delayed by GCRMTC. The GCRMTC is making every attempt to acquire the system. Task 6 and 7 rely heavily on the system availability. Additionally, *BOEING* personnel need this equipment for the upcoming workshop #2.

TASK 6 BUILD ONE ASSESSMENT

Task 6 requires the Build One to be complete. The contract obligation is to conduct an assessment work shop. The objective here is to provide the team members with a general understanding of how to use and administer the Build One RAM database. The requirements have been satisfied and once again the hardware/software availability is essential to this task. A portion of the workshop #2 has been designated to begin the assessment of the Build One phase of the Project.

TASK 7 BUILD TWO REQUIREMENTS DEFINITION

At the upcoming workshop #2, the Build Two requirements definition will begin. A portion of the workshop #2 will be dedicated to the Build 2 requirements' process. Task assignments will be given to all participants and the Build Two start will be right on schedule. At this point the Sub-contract will be at its midpoint and preparation for the final workshop #3 and the Final Report. The GCRMTC facilities located at the University of New Orleans in New Orleans, LA. will be the place of the meeting. This event is tentatively scheduled for mid June 1997.

TASK 8 BUILD TWO DESIGN

TASK 9 BUILD TWO PROTOTYPE DEVELOPMENT

TASK 10 BUILD TWO ASSESSMENT

TASK 11 PROJECT MANAGEMENT

Project Management activities are within the scope of the contract and on schedule with the current tasks and Build development. The Program Manager, Chuck Amaral of *BOEING*, is attending all available standards activities meetings regarding ISO 10303 and ASTM F25.

SHIPYARD ACTIVITY

NASSCO

BOEING has established a means of communication with the National Steel and Shipbuilding Company (NASSCO) of San Diego, CA and ARCO Marine, Inc. of Long Beach, CA. On the 23rd of August '96, Chuck Amaral and Vernon Kimura of *BOEING* traveled to NASSCO facilities and met with David Van Patten, Manager, Integrated Logistics and Chuck Byrne, Logistics Engineer - LSA. This technical exchange involved an overview of this project and the SEM methodology from *BOEING* and an overview

of the Logistics environment in a shipyard from NASSCO personnel. Chuck Byrne is certified in Reliability Centered Maintenance and gave *BOEING* a brief tutorial on RCM.

Mr. Chuck Byrne of NASSCO has been an excellent contributor of information and task analysis to this project. In consideration of his expertise and Navy certification in Reliability Centered Maintenance (RCM), Chuck, has been requested, by the Project Manager, to give a presentation on RCM to the RAM expansion team. The objective here is to inform the team of RCM, get their feedback to this process and proceed to include or exclude this process in the Enterprise Model. Mr. Byrnes is also a qualified instructor in the subject matter. Additionally, Dr. Inozu of the GCRMTC will present some optional commercial RCM processes that are currently available today and provide the team with some handout literature. The objective here is to have the team members take this information back to their respective organizations and within a 30 day period give feedback to *BOEING*. A matrix chart will be created for a comparison analysis tool.

NEWPORT NEWS SHIPBUILDING

Newport News Shipbuilding was one of the first to sign-up to this project and continued to support through out the proposal cycle and the extensive time before award. Newport News determined that they cannot support all the efforts that are going around with in-kind contributions. In order to support this project they would need resources for labor and travel. Because of the essential need for Newport News *BOEING* agreed to pay for two personnel to support at a cost of $10,000, plus $2,000 for travel expenses. The agreement is now in effect. There has been a change in the locations of the workshop #2. Originally, the workshop was scheduled to be held at the Newport News Shipbuilding facilities. However, the GCRMTC suggested that we conduct workshop #2 at the University of New Orleans facilities in New Orleans, LA. The rationale is that we may attract more participation at the workshop if we conduct it in the Gulf Coast Region. However, NNS has indicated that they did not allow for the travel and expenses and the change will require more funding (approximately $2100) for NNS personnel to attend and participate.

Newport News Shipbuilding hosted the first workshop #1 at their facility in Newport News, VA. on the 24-25 September '96. NNS is another very supportive organization under the guidance of Mr. John J. Keegan. Mr. Dan Selfridge was appointed as the NNS point of contact for this project. Mr. Selfridge is another participant who has been very responsive to this project with his technical contribution and inputs. Mr. Selfridge has suggested the importance of the Work Breakdown Structure (WBS) to the Shipyards and suggested that we review the Expanded Work Breakdown Structure (EWBS). Once again the Project Manager requested Mr. Selfridge to present at workshop #2 the EWBS. The rationale here is to make the participants aware of the importance of a WBS process and to receive their feedback for consideration of any other WBS they may be in existence today. The end product will be the inclusion of a neutral WBS platform that can be included in the RAM enterprise model.

AVONDALE INDUSTRIES

Mr. David Samiagio is representing Avondale Industries as a team member. Mr. Samiagio is another activity participant in this activity and has responded to all the task assignments issued at workshop #1.

BOLLINGER & INGALLS

Bollinger and Ingalls have requested to be invited at the workshop #2. They were not available for workshop #2.

SHIP DESIGNERS

M. ROSSENBLATT & SON, INC.
The ship designer attended our last workshop #1 and was very active in that session. Our point of contact, Mr. David R. Rodger, Assistant Vice President, has been very supportive of this project. He has provided with a local representative to participate in our workshops.

MANUFACTURERS AND VENDORS

We have not received much response from this area. However, we are committed to work on this by soliciting participation at workshop #2 by telephone, FAX, E-mail, and mail. Mr. Dale Rome of Carderock has offered his assistance in helping to stimulate the Manufacturers and Vendors to participate. This assistance should be very beneficial to this project and deeply appreciated by the Project Management staff.

CSI of Knoxville, TN, the Manufacturer of electronic instrumentation, firmware, and software for predictive maintenance and provision of calibration services. CSI has been assessed by ABS Quality Evaluations, Inc. and found to be in compliance with the quality standards ISO 9002. CSI has been an active participant in our workshops and has supported our efforts. CSI has created a methodology called "Reliability-Based Maintenance (RBM)." The RBM is a strategy to improve industrial productivity by integrating: preventive Maintenance (time or schedule based); predictive maintenance (condition based); and proactive maintenance (root cause based). CSI declares they have a proven method for reducing downtime and maintenance costs. In the RBM methodology maintenance needs are: forecasting; production capacity is increased 2-30%; emergency work orders and unplanned overtime are reduced; safety is enhanced; spare parts inventory is reduced; equipment life is increased. The results are less maintenance and more production.

Mr. Ted Sestak, District Manager and Reliability-Based Maintenance Consultant for CSI has agreed to attend our workshop #2 and brief the team on RBM and how it can be harmonized with RCM. This briefing session is to inform the team about strategies that are available and have them determine the need or practical usage for methodologies such as this and RCM. We have also agreed to allow CSI to give a demonstration (proof of concept) after the workshop session on the second day.

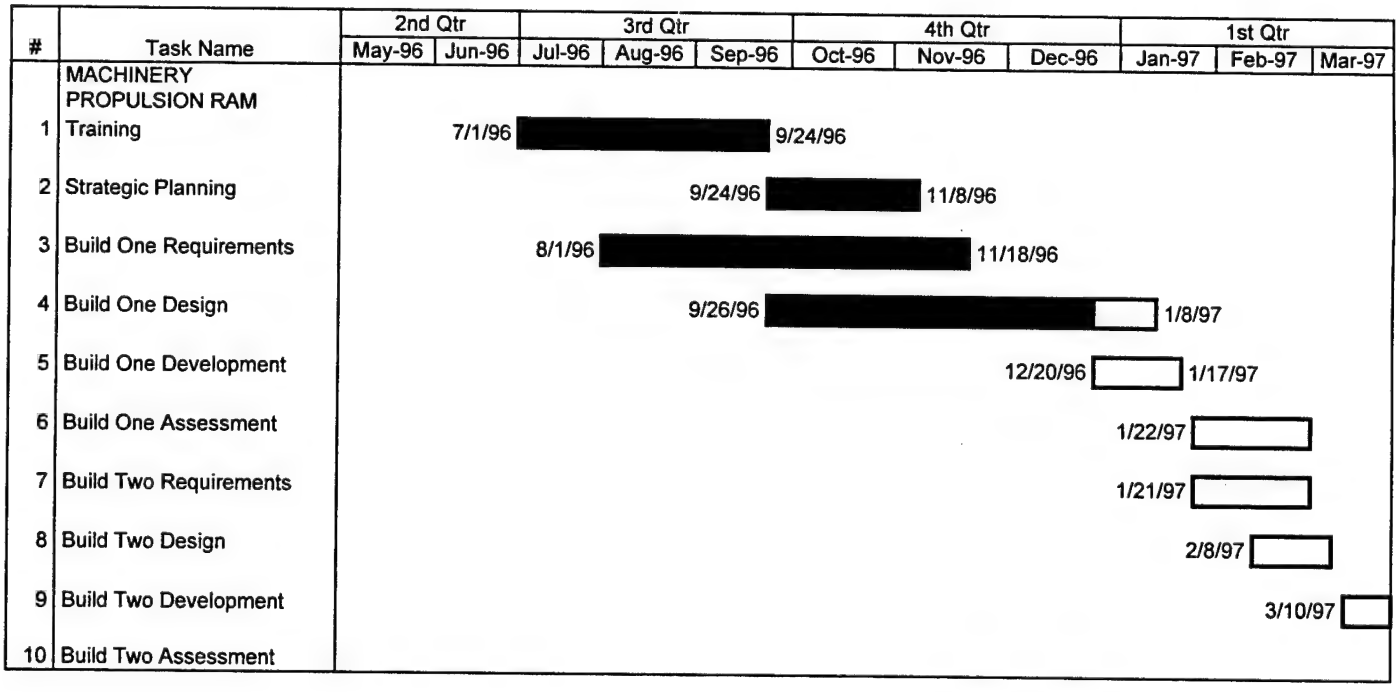
PROJECT FINANCIAL AND SCHEDULE STATUS

The project is on schedule and within cost. Further details can be viewed in the following Financial Status Report and Schedule.

ADVANCED AIR VEHICLE SYSTEMS AND
RESEARCH ENGINEERING & TECHNOLOGY DEVELOPMENT CONTRACTS
FINANCIAL STATUS REPORT - CUM THRU NOVEMBER 1996

D. CARTER

G.O. 15822		ACT CUM THRU WK50		CUM THRU NOV96			Est. to Complete		Est. at Complete	
Type: FP		Monthly Estimate	Actuals	Estimate	Actuals	Variance B (W)	Open Commitment	Uncommitted (Estimate)	Budget	Dec-96 LRE
Program: Expansion of the GCRMTC Ship's RAM Database	Lbr$	$28,427	$25,876	$137,473	$134,494	$2,979		$190,823	$325,317	$325,317
OPR: C. Amaral J. Willis	Other$	$2,614	$1,925	$15,959	$15,699	$260	$0	$46,384	$62,083	$62,083
Cont. Adm. C. Price	Total$	$31,041	$27,801	$153,432	$150,193	$3,239	$0	$237,207	$387,400	$387,400
DVD98-011-SJ66, X4604	Remarks	% Expended/ Committed of EAC 38.8% Fully Funded						Target Cost	$387,400	$387,400
Period of Performance: 5-9-96 thru 5-31-97								Target Proj. Fee	$22,600	$22,600
								Contract Value	$410,000	$410,000



ACCOMPLISHMENTS

1.) Conducted workshop #1 at Newport News Shipbuilding facilities

2.) BOEING North American Aircraft Division is now an Associate Member of SOCP

3.) Chuck Amaral is a committee member of ASTM

4.) Attended a workshop conducted by CSI

5.) Prioritized the list of Units of Functionality (UoF)

6.) High prioritized UoFs have been defined into five statements to establish the Build One requirements definition

7.) Presented an In-process review to the Program Manager, Mr. Dale Rome, and to the GCRMTC Executive Director, Dr. John Crisp.

8.) Data assertion statements are structured into an ARIM

9.) Reviewed ISO Application Protocols AP 216 and AP 218 for candidate data structures for the GRMTC Enterprise Information Model

10.) Reviewed Ship Inspection Report (SIR) software Tool

11.) Compiling software implementation documentation

12.) Ordered hardware/software from the GCRMTC

13.) Developed agenda for the upcoming workshop #2 and established the logistics for attendees

14.) Attended the ISO and ASTM standards meetings

15.) *BOEING* is reviewing the latest version of DATE & SHIPPER

KEY TECHNICAL ISSUES

The main issue is the integration of the Yard RAM with the SOCP effort.

Another technical issue is the Integration of the RAM database with the Coast Guard's MSTEP program.

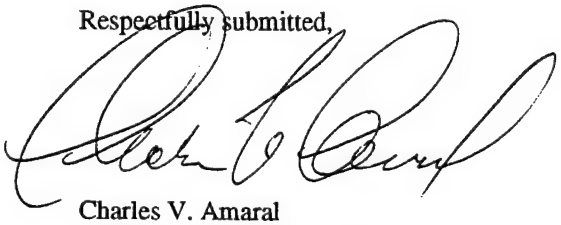
CONCLUSIONS AND RECOMMENDATIONS

This project's objective is to establish a network of communications throughout the Maritime Industry. The sharing of information will be unique to the industry. By conducting meetings with the Ship Operators and Owners, and the Ship Designers, Ship Builders, Manufacturers, and Vendors the SEM will knock down the barriers that have existed over a number of years. There will be near and long term benefits derived from the merging of the SOCP effort and this project.

Taking part in standards development and working with the regulatory agencies will reduce the boundaries that have existed. The SEM will bring structure to an activity. The ground work has been established and the Build process is beginning to take effect as planned. It is anticipated that the result of this project will grow rapidly and the implementation will expand within a few years. The long term results will impact the Maritime Industry Worldwide. It is difficult to scope what impact this will have in the long term. The potential may be mind boggling.

It is a recommendation that the SEM methodology be incorporated in the Ship Owners and Operators contract. This will help to establish structure, standardization, planning, scheduling, and management of the project. The Expansion project is using the SEM to perform the required tasks under contract. Eventually, the two projects will be merged into the Master Database. Uniformity and conformity will assist the integration effort.

Respectfully submitted,



Charles V. Amaral
Project Manager Maritime
Advanced Information Engineering

APPENDIX R

M. ROSENBLATT & SON, INC.
SUBCONTRACT REPORT

UNIVERSITY OF NEW ORLEANS SUBCONTRACT #24

Principal Investigator:

Thomas R. Schiller
Project Manager
M. Rosenblatt & Son, Inc.

University of New Orleans
New Orleans, LA 70148

M. ROSENBLATT & SON, INC.

SECOND QUARTER PROGRESS REPORT

PORTFOLIO OF WORLD CLASS SHIP DESIGNS

COOPERATIVE AGREEMENT NO. N00014-94-2-0011

SUBCONTRACT #24

TASK ORDER 001

REPORT PERIOD: October 1, 1996 - December 31, 1996

SUBMITTED TO:
University of New Orleans
Gulf Coast Region Maritime Technology Center

SUBMITTED BY:
M. Rosenblatt & Son, Inc.
2341 Jefferson Davis Highway, Suite 500
Arlington, Virginia, 22202-3885

PORTFOLIO OF WORLD CLASS SHIP DESIGNS

SECOND QUARTER PROGRESS REPORT

October 1, 1996 - December 31, 1996

PROJECT SYNOPSIS

The Portfolio of World Class Ship Designs project was initiated on June 1, 1996 by M. Rosenblatt & Son, Inc. (MR&S) under a Subcontract with the University of New Orleans. The period of performance under this contract is from June 1, 1996 to May 31, 1997. The objective of work in this project is to facilitate the development and availability of a Portfolio of World Class Ship Designs based on new and innovative technologies. The Portfolio will provide U.S. shipyards with a ready, up-to-date reference of marketable ship designs and the tools to quickly tailor the designs to specific customer requirements, thereby allowing the shipyards to bid confidently and competitively in the world shipbuilding market. The portfolio will be made available to U.S. shipyards in an electronic format and will consist of standardized ship designs of a number of ship types, design synthesis models, a production program for labor and cycle time and a product model database. The Gulf Coast Region Maritime Technology Center will be the custodian of the Portfolio of World Class Ship Designs.

The actual tasks are outlined in MR&S proposal dated Sept. 15, 1995 and as discussed in MR&S letter dated April 3, 1996 to Dr. John N. Crisp, Executive Director, Gulf Coast Region Maritime Technology Center at the University of New Orleans (UNO). MR&S personnel met with representatives of the University of New Orleans for the project Kick-Off meeting at the University of New Orleans on July 1, 1996 and the First Quarterly Meeting on October 7, 1996. MR&S is coordinating the efforts of the shipyard team members Avondale Industries, Inc. and Ingalls Shipbuilding, Inc. MR&S met with the staff of the UNO SBD Center in Orange, Texas on 4 November,. 1996 to establish a strategy for the Center to provide visualization and engineering support to the Portfolio of World class Ship Designs project.

BUDGET STATUS:

TOTAL AMOUNT BUDGETED:	$356,000
FUNDS REMAINING:	$178,000

ACCOMPLISHMENTS THIS PERIOD:

TASK 1: Market Survey and Analysis - The team conducted a review and analysis of recent existing shipbuilding market forecast studies as well as applicable reports and articles published in leading maritime periodicals and magazines. In addition, the existing population of various ship types have been documented from independent sources and the results were integrated with the results of the market forecast analysis for the following ship types (see Figure 1):

- o Tanker
- o Bulk Carrier
- o General Cargo Ship
- o Container Ship
- o Roll-On/Roll-Off Ship
- o Passenger Ship

The team established "criteria" for identifying the most market worthy design within each ship type and the designs most suitable to be built competitively in U.S. Gulf Coast shipyards. The test parameters include percent of existing population, percent of total market demand, demand within the specific ship type, competition, complexity, size, and relative dollar value. A preliminary draft of the Market Survey and Needs Analysis Report was prepared and submitted to the shipyard team members for review and comment. A response was received from Avondale Industries, Inc. and the response form Ingalls Shipbuilding, Inc. is expected shortly. The shipyard comments will be incorporated into the final report. The results of the market survey and needs analysis provide the input to the Selection of Ship Type task.

TASK 2: Production Technologies Review - The team conducted a review and analysis of existing literature and studies on advanced shipbuilding production processes and technologies as well as applicable reports and magazine articles. One of the most significant studies has been conducted under the supervision of the National Shipbuilding Research Program (NSRP). The NSRP funded a competitiveness survey of U.S. shipyards in 1978, and a follow-on study, "Requirements and Assessments for Global Shipbuilding Competitiveness" was published as NSRP Report 434 in March 1995. The chapter on "Recommended Areas to Target in Order to Increase Competitiveness" is a comprehensive guide for U.S. shipyards to follow in order to evaluate their competitive position and to develop an internal strategy for improvement (see Figure 2). Since most of the new processes and technologies are being developed by successfully competitive shipyards, the team has consulted with a number of "world class" shipyards for their input. The team is soliciting input from shipyard team members to identify any new technologies or production process improvements which should be considered. A Facilities and Production Technologies Report will be prepared which incorporates the shipyard comments. This report will be up dated periodically to include any new findings.

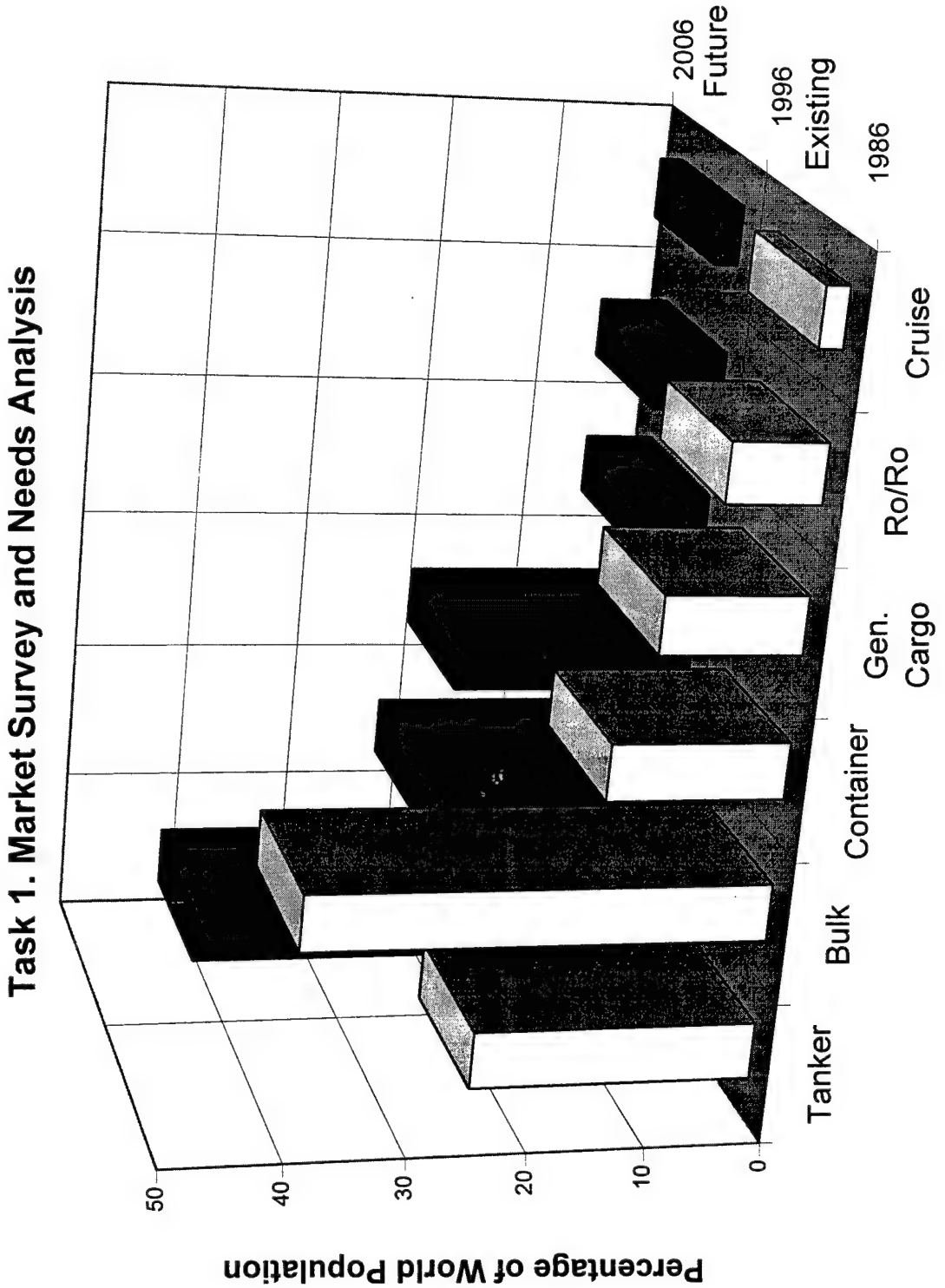

Task 1. Market Survey and Needs Analysis
Percentage of World Population
0
10
20
30
40
50
Tanker
Bulk
Container
Gen. Cargo
Ro/Ro
Cruise
1986
1996 Existing
2006 Future

Figure 1

Task 2. Production Facilities and Technology Review

NSRP Report 434, "Requirements and Assessments for Global Shipbuilding Competitiveness", March, 1995.

Facilities Improvements

- Business Plan
- Shipbuilding Policy
- Marketing
- Design and Engineering
- Build Strategy
- Material Management
- Purchasing
- Make, Buy, Sub-Contracting
- Estimating
- Process Lanes
- Block Assembly
- Outfitting

Applicable Technologies

- New Primers
- Automatic/Robotic Process
  - Painting
  - Welding/Forming
- CAD/CAM/CIM
- TQM and Accuracy Control
- Ancillary Construction Equipment
- Prefabrication and Modularity

Figure 2

TASK 3: Design Synthesis Model (chemical tanker) - The effort to date involved the development of the architecture for this computer program which is essentially complete for the first ship type (chemical tanker). The functional flow was defined for the major logical loop beginning with initializing hull dimensions (see Figure 3). Once initialized, the program calculates the displacement, tank volumes and centers, weights, fuel, trim and stability, and speed for a range of lengths, beams, and drafts. In the final step, the program interpolates these results to arrive at the solution ship with the required payload, speed, and range. In addition to principal ship's characteristics, the architecture contains a cost estimating subroutine. Computer code is under development for the primary synthesis and interpolation. A ship's equipment catalogue which will reside in the synthesis program is being developed for major pieces of equipment. Selected items will appear on the Master Equipment List.

TASK 4: Selection of Ship Types - The market survey and needs analysis identified six major ship types; tanker, bulk carrier, general cargo ship, container ship, roll-on/roll-off ship, and passenger ship (including passenger ferries). The six ship types were subjected to test parameters to select and prioritize the most market worthy designs for building competitively in U.S. Gulf Coast shipyards. The results of the selection process for the four baseline designs to be developed under the scope of this project are:

- o Chemical Tanker, IMO Class I & II
- o General Purpose General Cargo Container Carrier
- o Roll-On/Roll-Off Passenger Ferry
- o Container Ship

A Chemical Tanker of approximately 15,000 DWT was selected as the first baseline ship for further development. All four of the baseline ships will have similar characteristics as further described in the Concept Study task..

TASK 5: Concept Studies - The team sought to maximize commonality in ship designs for producibility; investigating all ship types to establish/confirm the principal characteristics of a portfolio series. The investigation focused on tankers and containers ships as representative models of weight limited and volume limited ships. The review and analysis of database particulars resulted in the following characteristics.

Table 1: Fairplay World Ship Population Study

Ship Type	LBP	Beam	Depth	Draft	DWT	Speed	BHP
Container	150.0	25.0	13.1	9.2	17,200	17.1	12,500
Chemical Tanker	150.0	24.7	13.1	9.6	21,500	14.3	8,300

The characteristics were further refined (to use the same hull form for all ship types) utilizing additional data from PNA, Watson and Gilfillan, and design notes. The bow module and stern module have been optimized for the containership since this variant has the higher power requirement. The cargo modules are standardized structurally to provide the maximum

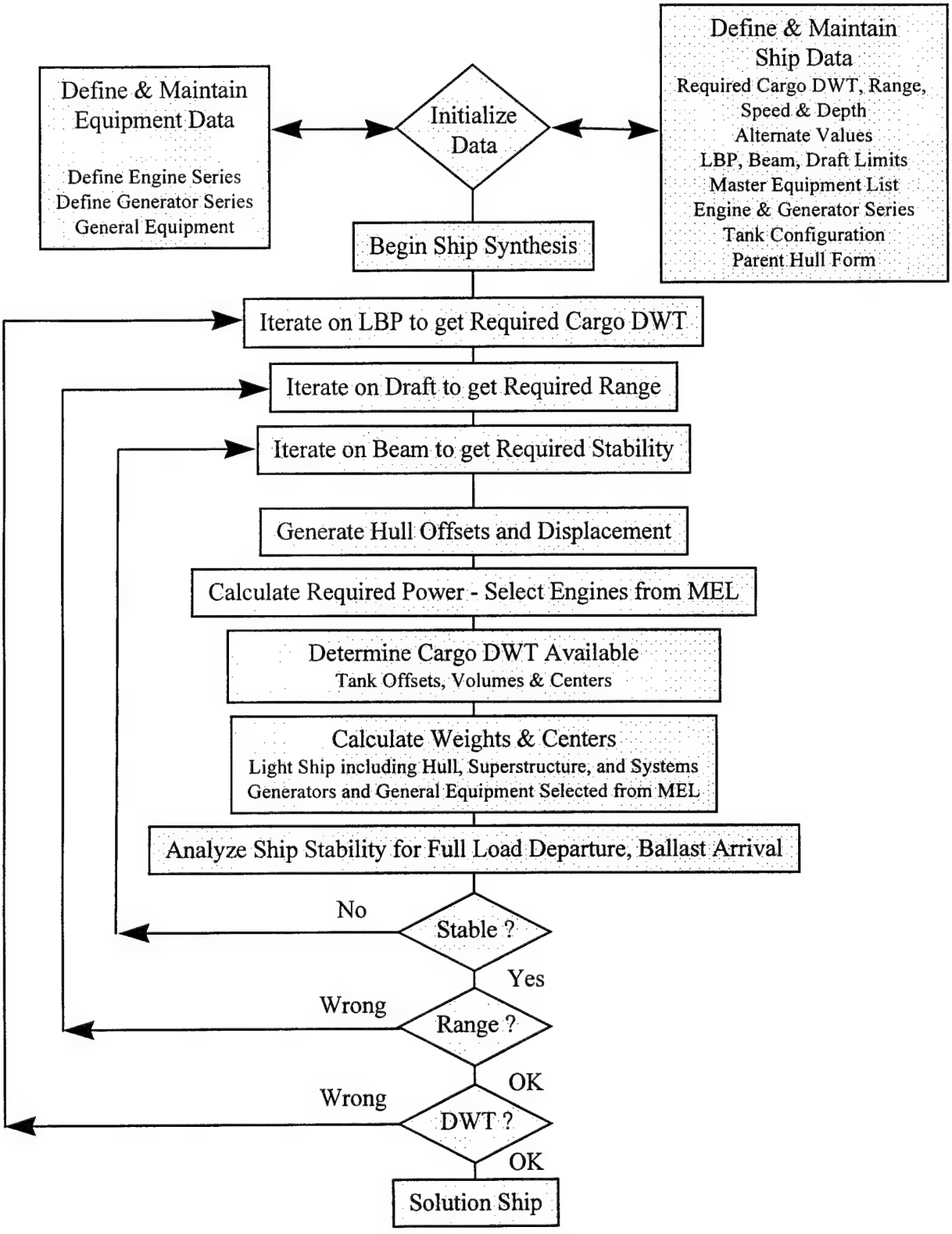


Figure 3 Ship Synthesis Model for Weight Limited Ship

commonality for production while remaining compatible with the bow and stern modules. Roll-on/roll-off ships will require increased hull depth while the remainder of the design remains the same. The container ships will require a modified deck house configuration; the basic house blocks remain the same but are assembled in a different configuration. (see Figure 4).

TASK 6: Point Design Development (First Ship) - A Point Design has just been initialized for the first selected ship type; a chemical tanker. The point design is based on a generic build strategy (GBS) modified as necessary to suit the shipyards. The design approach utilizes "Zonal" Architecture and Product Oriented Design and Construction (PODAC) approaches. The level of detail of the point design will be sufficient for use as a test case to validate the tanker synthesis model program. The point design will also be developed in sufficient detail to be used by shipyards as a marketing tool (see figure 5).

The UNO/GCRMTC Simulation based design Center is developing a 3D ship visualization in parallel with the development of the four point designs. Based on the selected ship characteristics of the particular point design, a 3D surface model is being developed. As general arrangements are determined, the internal details of the models are added. As the point designs are further developed, the models are refined to include structure and distributive systems. The final models will be interactive to allow the user to utilize the SBD Center's visualization capabilities to suit their particular needs, such as build strategy development, detail block development and assembly, and marketing video production.

TASK 7 - Product Model Data (Master Equipment List) - The team consulted with other technology development activities such as the Mid-Term Sealift ERAM Project to obtain existing product model data. Applicable product model data was assembled and Vendors were approached to provide additional commercial equipment data as necessary to develop a commercial Product Model Library for ship' equipment. The database was formatted based on currently accepted protocols for electronic data exchange.

PROPOSED ACTIVITIES NEXT PERIOD:

Task 2: Production Technologies - Continue search for new production processes and technologies, both domestic and foreign.

Task 3: Synthesis Model - Continue code development for tanker synthesis program. Commence architecture development for second ship type.

Task 5: Concept Studies - Complete validation of standard component concept. Report Results.

Task 6: Baseline Point Design (First Ship Type); 3D Graphical Presentation - Develop point

Task 5. Concept Studies

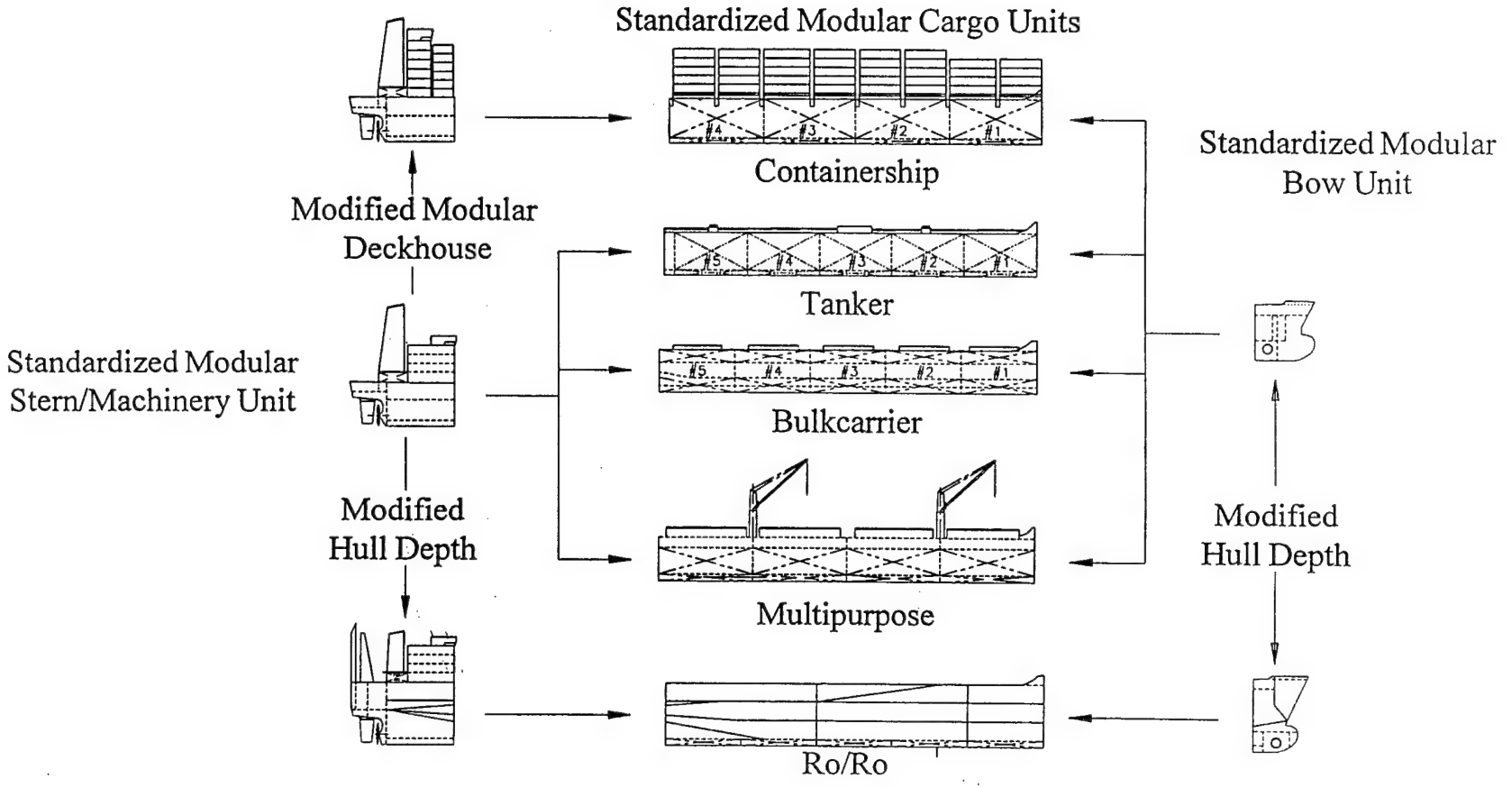
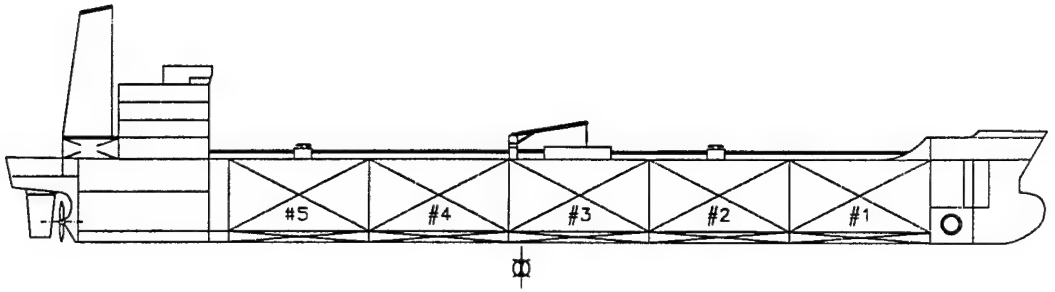
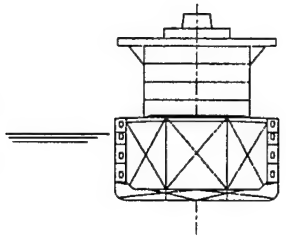


Figure 4

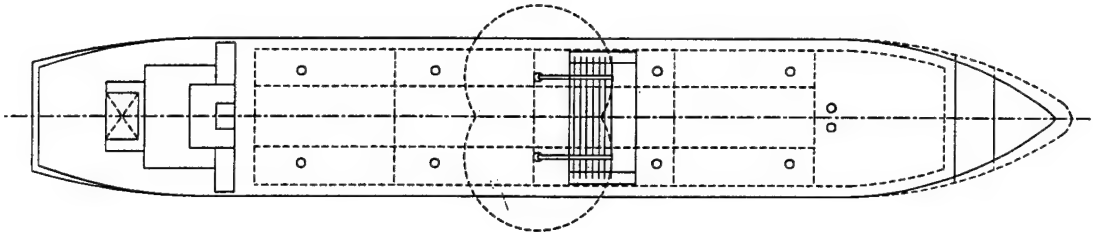
Task 6. Point Design Development - Chemical Tanker



Inboard Profile



Section View



Plan View

Main Particulars

LOA	160.0 m
LPP	150.0 m
B	24.75 m
D	13.0 m
Design Draft	10.2 m
Deadweight	21,300 MT
Speed	14.7 knots

Figure 5

design specifications, general arrangements, and outfitting. Provide input to UNO SBD Center for development of 3D graphical presentation.

Task 7: Master Equipment List/Product Model Data - Populate synthesis program database with major equipment items. Develop format for Ship's Equipment Catalogue (Product Model Database).

COLLABORATIVE EFFORTS:

DOLLAR VALUE OF SERVICES FROM INDUSTRY	
IN KIND SERVICES:	N/A
ACTUAL FUNDS:	N/A
DOLLAR VALUE OF SERVICES FROM GOVERNMENT	
IN KIND SERVICES:	N/A
ACTUAL FUNDS:	N/A
NUMBER OF SIGNIFICANT CONTACTS	
INDUSTRY:	3
ACADEMIC:	N/A
GOVERNMENT:	N/A

COMMENTS:

Reefer Express Lines, Inc. is considering the purchase of chemical tankers. Avrum A. Freelund, their consulting engineer, has been contacted and has agreed to provide owner/operator input to the development of the Portfolio of World Class Ship Designs.

Stolt Parcel Tankers, Inc. is a major tanker owner operator. Thomas E. Graf has been contacted and expressed an interest in participating in the Portfolio of World Class Ship Designs project.

Fincantieri, SpA, Merchant Shipbuilding Division has expressed an interest in providing input to the Portfolio development project; e.g., technology transfer in the areas of advanced shipbuilding process technologies and current ship data..

The NSRP project 6-92-2, Vendor Furnished Information Guidelines is a related project and the teams will collaborate to share results and to avoid duplication.

The portfolio project is proceeding in general accordance with the schedule and budget. No major problems have been identified and the planned activities for the third quarter should be completed on time and on budget.

CURRENT STATUS GANTT CHART:

The first year Gantt Chart for the Portfolio of World Class Ship Designs Project, reflecting the current status of the tasks is shown in Figure 6.

First Year Schedule

Proposed and Actual Schedule

No.	Task Name
1.	Market Survey and Analysis
2.	Facilities and Production Technologies Review
3.	Design Synthesis Model
	Architecture
	Database
	Cost Modeling
	Validation and Verification
4.	Selection of Ship Types for Development
5.	Concept Studies
6.	Develop Point Designs
	Design No. 1
	Design No. 2 (Start Year 2)
	Design No. 3 (Start Year 2)
	Design No. 4 (Start Year 2)
7.	Obtain Product Model Data (MEL) (Start Year 2)
8.	Develop Production Program (Start Year 2)
9.	Benchmark the Production Program (Start Year 2)
10.	Implementation Plan

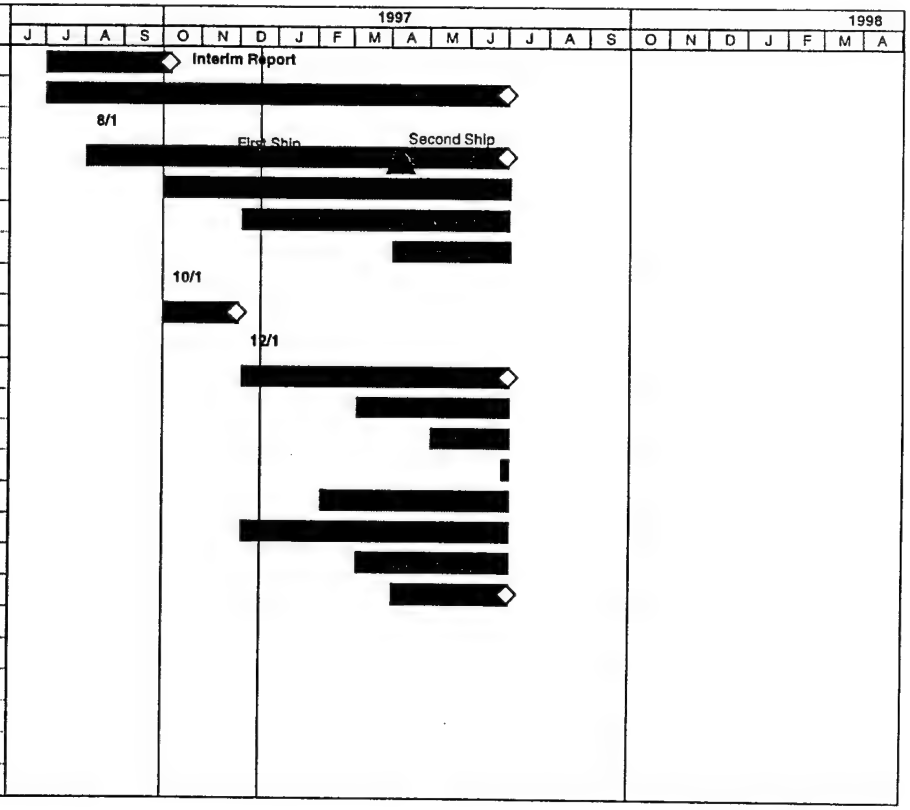


Figure 6

APPENDIX S

CYBO ROBOTS, INC.
SUBCONTRACT REPORT

UNIVERSITY OF NEW ORLEANS SUBCONTRACT #23

University of New Orleans
New Orleans, LA 70148

Cybo Robots
Quarterly Status Report
October 1 - December 31, 1996

Submitted to University of New Orleans
Office of Research and Sponsored Projects
Subcontract #23
Task order #001

Budget Status

At the end of December this project will be approximately 40% complete in regard to project duration. However this project becomes much more engineering intensive in the last 6 months. This is due to the generation of software and analysis based off the weld samples.
Current project expenditure

Labor: $18,980 (estimated)
Material & travel: $900 (estimated)
Partner cost: $8,500 (estimated)

Accomplishments this period

Developed neural-net training experiment list.
Developed detailed test sample requirements and subcontracted shipyard to manufacture them ensuring they meet production painting standards.
Completed acceptable welds on approximately 20% of test sample list, see chart.
Established the software interface methodology between the neural-net algorithm and the Off-line Planning system.
Developed a first draft for text based weld specification and circulated it to shipyards for review. This is geared at covering a high percentage of welds, not 100%.

Proposed Activities for Next Period

Obtain test samples from shipyard with proper paint characteristics
Complete experiment testing & submit results to N.A. Tech.
Generate first draft of weld parameter database
Start training the neural-net based on experimental results and identify any additional experiments.
Start integration of the neural-net algorithm with AOLP

Weld Specification Format
Text Format

The following text based weld method for specifying welds is proposed for transferring weld specifications between design database and Off-line programming systems. The goal is to embed this information into the ship database such that it could be transferred within the Neutral Format Transfer File. This format is only geared to transfer weld specifications, not weld process. Initially the system will deal with basic weld types. Its format is flexible so that it can be expanded on in the future.

A 9 field text string will be used to describe the basic weld specification. Each field will be separated by a comma. Note that several of the fields will have default specifications, thus reducing the amount of operator interface. For example the default skew angle for a fillet is 90 degrees. The following initial set of attributes are defined:

1	2	3	4	5	6	7	8	9
Fillet	**Leg 1**	**Leg 2**	**Gap**	**Skew**				
Lap	**Leg 1**	**Leg 2**	**Gap**	**Matl. thickness**				
Groove	**Depth 1**	**Depth 2**	**Root opening**	**Left angle**	**Right angle**	**Reinforcement height**		

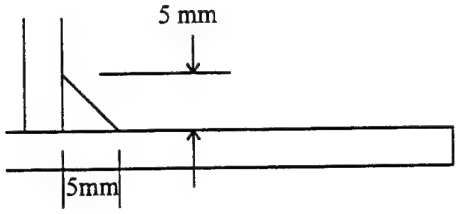
Fillets
Leg 1 - Leg size (mm.) of the continuous plate.
Leg 2 - Leg size (mm.) of the intersecting plate.
Gap - This is the max allowed root gap (mm.) allowed without requiring automatic re-sizing of the fillet size. Default is 0.
Skew - Included angle of the intersecting members. Default is 90 deg.

Laps
Leg 1 - Leg size (mm.) of the continuous plate.
Leg 2 - Leg size (mm.) of the top plate.
Gap - This is the max allowed root gap (mm.) allowed without requiring automatic re-sizing of the fillet size. Default is 0.
Matl thickness - This is the thickness (mm.) of the top plate.

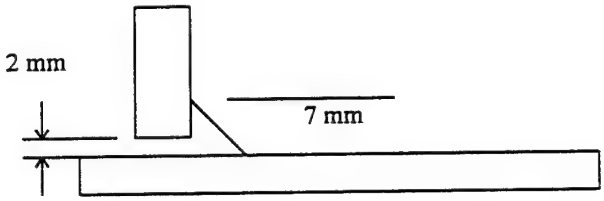
Groove
Depth 1 - Thickness (mm.) of the left plate (in direction of travel).
Depth 2 - Thickness (mm.) of the right plate (in direction of travel).
Root opening - Nominal root opening (mm.)
Left angle - Edge prep. angle (degrees) of the left plate.
Right angle - Edge prep. angle (degrees) of the right plate.
Reinforcement height - Additional height of weld above the plate height.

Examples

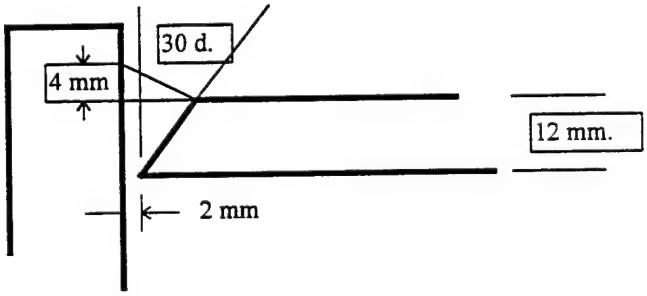
A standard, garden variety 5 mm. fillet would be specified as:
Fillet, 5, 5



A standard 5 mm. fillet with a maximum allowed gap of 2 mm. would be specified as:
Fillet, 5, 5, 2
Note a default adaptive strategy would be to increase the leg size by the measured gap if found to be over 2 mm.



A groove weld with a 30 deg edge prep and a reinforcement height of 4 mm as:
Groove (bevel), 12, 12, 2, 0, 30, 4



Weld Test Parameters

Experiment No.	Work Angle	Pos.	Gap (mm)	CTWD	ipm	mm/sec	ipm	mm/sec	VOLTS	Material T	Lead/Lag Angle
1	35	2F	0	0.75	150	63.45	15	6.35	22	0.25	-10
2	55	2F	0	0.875	400	169.20	15	6.35	22	0.25	10
3	35	1F	4	0.875	400	169.20	4	1.69	22	0.5	-10
4	55	1F	4	0.875	400	169.20	4	1.69	26	0.5	10
5	55	3F	4	0.625	320	135.36	15	6.35	26	0.5	10
6	55	3F	0	0.875	150	63.45	15	6.35	22	0.25	-10
7	55	4F	4	0.625	150	63.45	4	1.69	26	0.5	10
8	35	3F	0	0.625	320	135.36	15	6.35	26	0.5	-10
9	35	2F	0	0.625	400	169.20	15	6.35	26	0.25	10
10	40	3F	0	0.625	150	63.45	4	1.69	22	0.5	10
11	55	2F	4	0.875	400	169.20	4	1.69	22	0.25	-10
12	35	3F	4	0.875	150	63.45	15	6.35	26	0.25	-10
13	35	4F	4	0.75	400	169.20	15	6.35	22	0.25	-10
14	45	3F	0	0.875	400	169.20	15	6.35	26	0.25	10
15	35	4F	4	0.875	320	135.36	4	1.69	24	0.5	10
16	55	4F	4	0.875	400	169.20	4	1.69	26	0.5	-10
17	55	2F	2	0.75	400	169.20	4	1.69	26	0.25	10
18	55	1F	0	0.625	400	169.20	15	6.35	26	0.5	-10
19	35	1F	2	0.875	150	63.45	4	1.69	26	0.25	10
20	35	4F	0	0.625	150	63.45	15	6.35	24	0.25	0
21	50	2F	4	0.875	260	109.98	15	6.35	22	0.5	-10
22	55	2F	0	0.625	150	63.45	4	1.69	22	0.5	-10
23	55	1F	4	0.875	150	63.45	4	1.69	26	0.5	-10
24	45	1F	2	0.75	320	135.36	8	3.38	26	0.5	0
25	55	3F	4	0.625	400	169.20	15	6.35	26	0.25	-10
26	35	2F	4	0.75	400	169.20	15	6.35	24	0.375	-10
27	55	3F	0	0.875	150	63.45	4	1.69	26	0.5	10
28	55	1F	0	0.875	150	63.45	15	6.35	26	0.25	-10

Weld Test Parameters

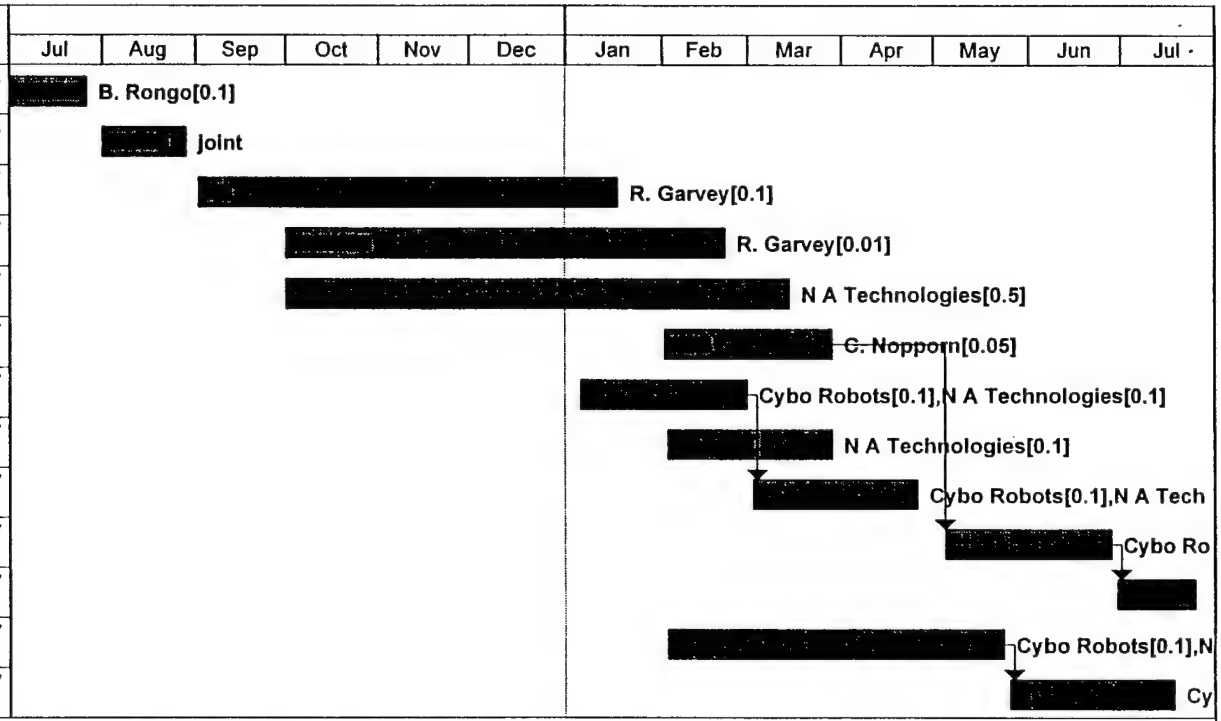
Experiment No.	Work Angle	Pos.	Gap (mm)	CTWD	ipm	mm/sec	ipm	mm/sec	VOLTS	Material T	Lead/Lag Angle
29	35	2F	4	0.75	150	63.45	4	1.69	26	0.5	-10
30	40	1F	0	0.625	400	169.20	15	6.35	22	0.25	-10
31	35	4F	0	0.875	150	63.45	8	3.38	22	0.5	-10
32	55	1F	4	0.625	150	63.45	15	6.35	26	0.25	10
33	35	1F	0	0.875	400	169.20	15	6.35	26	0.5	10
34	50	2F	4	0.625	150	63.45	4	1.69	26	0.25	10
35	35	2F	4	0.875	400	169.20	15	6.35	22	0.25	10
36	55	2F	4	0.625	400	169.20	15	6.35	22	0.25	10
37	40	4F	0	0.625	400	169.20	15	6.35	26	0.5	10
38	55	4F	4	0.875	150	63.45	15	6.35	26	0.25	10
39	40	3F	2	0.875	400	169.20	4	1.69	22	0.5	-10
40	35	2F	4	0.625	150	63.45	8	3.38	24	0.5	10
41	65	2F	2	0.625	150	63.45	15	6.35	26	0.375	-10
42	55	3F	4	0.875	150	63.45	4	1.69	22	0.5	10
43	35	1F	0	0.625	150	63.45	4	1.69	26	0.25	-10
44	55	1F	0	0.875	400	169.20	4	1.69	22	0.5	-10
45	35	2F	2	0.875	150	63.45	15	6.35	22	0.5	0
46	35	2F	4	0.625	320	135.36	4	1.69	26	0.375	-10
47	55	3F	0	0.625	400	169.20	4	1.69	22	0.25	10
48	45	4F	4	0.75	150	63.45	4	1.69	26	0.25	-10
49	35	1F	4	0.625	400	169.20	15	6.35	22	0.5	10
50	35	4F	4	0.625	400	169.20	15	6.35	26	0.5	-10
51	45	2F	0	0.875	150	63.45	4	1.69	26	0.375	10
52	55	1F	4	0.875	150	63.45	15	6.35	26	0.5	10
53	55	4F	4	0.625	400	169.20	8	3.38	24	0.25	10
54	35	4F	0	0.875	400	169.20	4	1.69	26	0.25	-10
55	55	1F	4	0.875	400	169.20	15	6.35	22	0.25	-10

Weld Test Parameters

Experiment No.	Work Angle	Pos.	Gap (mm)	CTWD	ipm	mm/sec	ipm	mm/sec	VOLTS	Material T	Lead/Lag Angle
56	35	2F	0	0.875	400	169.20	4	1.69	22	0.5	10
57	35	3F	4	0.625	150	63.45	4	1.69	22	0.25	-10
58	35	1F	0	0.625	150	63.45	15	6.35	22	0.5	-10
59	35	2F	4	0.875	320	135.36	15	6.35	26	0.5	10
60	45	2F	0	0.875	400	169.20	15	6.35	26	0.5	-10
61	55	1F	0	0.625	150	63.45	4	1.69	22	0.5	10
62	50	3F	4	0.75	150	63.45	4	1.69	26	0.375	-10
63	50	4F	0	0.875	400	169.20	4	1.69	22	0.25	0
64	35	4F	0	0.875	400	169.20	4	1.69	22	0.5	-10
65	35	4F	0	0.625	150	63.45	4	1.69	22	0.25	10
66	35	1F	4	0.625	400	169.20	4	1.69	22	0.25	10
67	35	3F	0	0.875	260	109.98	4	1.69	22	0.25	-10
68	35	3F	4	0.75	400	169.20	4	1.69	26	0.25	10
69	55	4F	4	0.625	150	63.45	15	6.35	22	0.5	-10
70	55	4F	0	0.625	260	109.98	15	6.35	26	0.25	-10
71	35	1F	4	0.875	150	63.45	15	6.35	22	0.25	-10
72	55	1F	4	0.625	400	169.20	4	1.69	22	0.5	-10
73	55	4F	2	0.875	400	169.20	15	6.35	22	0.375	-10
74	35	3F	4	0.875	150	63.45	15	6.35	22	0.5	10
75	55	1F	0	0.875	150	63.45	8	3.38	22	0.25	10
76	55	4F	0	0.75	150	63.45	15	6.35	22	0.5	10
77	55	3F	0	0.75	400	169.20	12	5.08	22	0.375	0

Samples completed are shaded

ID	Task Name	Duration	Start	Finish
1	Define Requirements	4w	Mon 7/1/96	Fri 7/26/96
2	Define learning experiments	4w	Thu 8/1/96	Wed 8/28/96
3	Develop test samples	20w	Mon 9/2/96	Fri 1/17/97
4	Weld samples	20.79w	Tue 10/1/96	Fri 2/21/97
5	Develop the neural-net based	23.8w	Tue 10/1/96	Fri 3/14/97
6	Develop software interface	8w	Sun 2/2/97	Fri 3/28/97
7	Develop operator/system inte	8w	Mon 1/6/97	Fri 2/28/97
8	Experiment analysis	8w	Mon 2/3/97	Fri 3/28/97
9	Integrate neural-net algorithm	8w	Mon 3/3/97	Fri 4/25/97
10	Refine model support	8w	Mon 5/5/97	Fri 6/27/97
11	Documentation & Report	4w	Mon 6/30/97	Fri 7/25/97
12	Weld database development	16w	Mon 2/3/97	Fri 5/23/97
13	Integrate database	8w	Mon 5/26/97	Fri 7/18/97



Project: schedule.MPP
Date: Sat 1/17/15

Task
Progress
Milestone
Summary
Rolled Up Task
Rolled Up Milestone
Rolled Up Progress

APPENDIX T

MACSEA LTD.
SUBCONTRACT REPORT

UNIVERSITY OF NEW ORLEANS SUBCONTRACT #20

Principal Investigator:

Kevin P. Logan
MACSEA Ltd.

University of New Orleans
New Orleans, LA 70148

Quarterly Progress Report #2

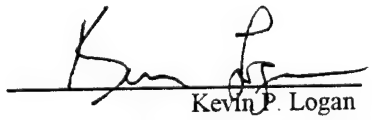
Subcontract #20; UNO #327-01-5100
Agreement No. N00014-94-2-0011

Prepared for:

Gulf Coast Maritime Technology Center
University of New Orleans
212 Engineering Building
New Orleans, Louisiana 70148

Prepared by:

MACSEA Ltd .
163 Water Street
Stonington, Connecticut 06378
Tel: (860) 535-3885 Fax: (860) 535-3357
e-mail: macsea@connix.com



Kevin P. Logan
Principal Investigator

MACSEA Ltd.
Quarterly Report #2

Report Period: October 19, 1996 to December 15, 1996
Project: *Automated Learning of Diesel Engine Operating Characteristics*
Principal Investigator: Mr. Kevin P. Logan

Brief Synopsis:

This is the second quarterly report for this project. The specific objectives of this research are as follows:

1. To develop automated machine learning techniques that can detect changes in a diesel engine's operating characteristics over time. Knowledge of such changes can lead to the determination of incipient engine problems before catastrophic failure occurs, thereby minimizing unplanned machinery breakdowns and maximizing reliability and readiness. When incorporated into a fully integrated engine monitoring, performance analysis, and diagnostic system as part of a U.S. built advanced technology ship, such techniques can provide an effective tool for minimizing maintenance and repair costs, as well as engine operating costs. Lower life cycle costs of U.S. built ships can improve the competitiveness of the U.S. shipbuilding industry in the international market.

2. To apply these techniques to learn the nonlinear relationships among key engine variables. The representation of these relationships can then be used for recall purposes, wherein a machine-computed estimate of a particular parameter can be generated on the basis of the other parameters. This opens up the possibility of employing the representation for data fusion and analytically redundant sensor estimation, with a direct application to sensor diagnostics.

Budget Status:
Total Amount Budgeted: $111,986
Funds Remaining: $70,452

Accomplishments This Period:

Task 1: Design Simulation Experiments

- Completed a file format specification for artificial neural network training and testing. The specification is included as enclosure (1).

- Requested a series of steady state and transient simulation runs that represent the full operating range of selected engine parameters. The most recent version of the Experimental Simulation Plan and Report is included as enclosure (2).

- Provided an engine governor make and model number to UNO. Provided a set of time-stamped at-sea recorded samples of engine RPM and engine load to facilitate the calculation of drive machinery inertia. Both of these were provided to increase the realism of the requested simulated data.

Task 2: Conduct Simulation Trials:

- UNO is performing the simulation runs mentioned above.

Task 3: Develop Real-time Neural Network Learning Techniques:

- Completed a search and review of the artificial neural network literature relating to function estimation and associative memory, especially spatially localized learning techniques and implementation of real-time learning. Function estimation is the problem of learning an unknown functional mapping between continuous input and output variables. Autoassociative memory is a special case of function estimation where the input and output variables are identical. It has been demonstrated that artificial neural networks are able to estimate any continuous function to arbitrary precision, given sufficient training data. The condition constrains the set of functions that can be practically estimated to those which are sufficiently smooth with respect to the sampling density of the training data. On-line learning also requires that the learning technique be spatially local, i.e. that a given training input significantly affect only a small number of network parameters (weights). This is due to the phenomena of "forgetting" observed in global learning methods: because all training data affects all network weights, current or recent training samples modify network weights that once accurately reflected early training samples. On-line learning denies the use memory-intensive techniques such as those which store all past training samples for use in processing unknown inputs. Real-time learning and execution further requires that the number of layers of learning units in the network be small. Automation of the learning algorithm requires that the number of user-adjusted parameters be minimal.

- Completed the study of candidate artificial neural network learning techniques based on the considerations outlined above, and selected two for implementation. A classification of artificial neural network architectures for automated real-time on-line function estimation and autoassociative memory is included as enclosure (3). The two selected networks are the Differentiable Cerebellar Model Arithmetic Computer (Differentiable CMAC) and the Dynamically Stable Learning Neural Network (DYSTAL).

Task 4: Conduct Neural Network Training Trials:

- Completed a series of analytic sensor redundancy experiments using an off-line global training method as a performance baseline for real-time on-line learning methods. The method chosen was the multiple layer perceptron artificial neural network trained using backpropagation. The results are described below.

- Previously built a database for neural network training using MACSEA-acquired power trial data as mentioned in Quarterly Report #1. The database contains time samples of engine parameters selected for use in the sensor redundancy experiments. The data recorded at sea was reviewed to support engine parameter selection for simulation runs. Backpropagation networks with various topologies were trained as nonlinear autoassociators of the engine parameters. Enclosure (4) page 1 gives an example of the result of testing a network with the training data – the least demanding test possible. The legend indicates "tagname" for the actual data, and "tagname^" for the network estimate of that data. In the power trial data, the tagname of engine brake horsepower (BHP) estimate is CO194. The test provides a lower bound on the error to be expected during testing.

- To achieve generalization, i.e. good performance when the network is faced with input other than the training data, the network should not be trained until convergence. If training continues until the error on the training set cannot be further reduced, the network mapping may overfit or "memorize" the training data. Used a more effective technique: a validation set which consisted of 10% of the samples was withheld from the training set. As training proceeded, occasionally tested the nonlinear association of the validation set with itself. Initially, the error on both the training set and the validation set decreased. Stopped training when the error on the validation set began to increase. Tested the ability of the backpropagation networks trained in this manner to generalize from the training data to perform data recovery. An estimate of engine BHP is critical to diagnosis of engine faults: the baseline reference for comparison to measured values for many engine parameters is correlated with BHP. Normally, BHP is estimated from sensor measurements. To test the network's ability to provide an analytically redundant estimate of BHP given a failure to estimate it normally, replaced all time samples of input BHP estimate with zeros. Recorded the network output at each time interval. The response is included as enclosure (4) page 2. The legend has the same meaning as the previous.

- In nonlinear association, feedback has been shown to be an effective technique. Tested its effectiveness in this application by feeding back the output of the network when BHP zero. More specifically stated, the input fed back consisted of the valid sensor data and the previous network estimate of BHP which resulted when the input BHP was zero. Obtained a much improved network BHP estimate as shown in enclosure (4) page 3. A comparison of the mean squared error (MSE), i.e. the average squared vertical distance between the actual BHP estimate and the network BHP estimate, obtained in the previous three trials, is given in enclosure (4) page 4.

- Conducted a sensitivity analysis of the selected engine parameters and ranked them in order of most significant to the output value to the least. Continued testing the above network. For each subsequent test, zeroed an additional parameter, in the order of least sensitivity first, until eight of the parameters were zero. Plotted actual value of BHP Estimate versus the network estimate of CO194 in each case. The last result included as enclosure (5) page 1.

- Used the feedback technique described above to improve the network estimate of CO194 in the case of eight simulated sensor failures. Enclosure (5) pages 2, 3, and 4 show the dramatic improvement possible. A comparison of the MSE for the trials with eight zeroed parameters is given in enclosure (5) page 5.

- Noted an MSE increase given repeated feedback in the case of a single zeroed input. Examples of the deterioration of the network's estimate of BHP in this case are given in enclosure (6) pages 1 and 2. A graph of the MSE for all cases is included as enclosure (6) page 3.

- The phenomenon described above emphasizes the need for a feedback stopping criteria. Unlike the artificial conditions of this experiment however, computation of the MSE of the sensor data to be recovered will not be possible in practice: the network output will be fed back only when no valid data is available from a given sensor. The strong correlation among the engine parameters, documented in Quarterly Report #1, suggested a solution; the preliminary results confirm it: in the trials run so far, the network estimate of valid sensor data improves or worsens in step with the network estimate of missing sensor data. One example is given in enclosure (7) page 1. It shows that the network estimate of valid data, the charge air pressure in the left bank of the engine, the tagname of which is T152, improves in parallel to the network estimate of missing data, the BHP estimate. For comparison, please see enclosure (5) page 5. Enclosure (7) page 2 shows that the network estimate of T152, which is valid data, improves and then worsens in step with the network estimate of CO194, which is invalid data. Please compare with enclosure (6) page 3. So it appears that the network estimate of missing sensor data can be fed back until the MSE of the valid sensor data begins to increase. This hypothesis will be tested further.

Proposed Activities Next Period:

Task 1: Design Simulation Experiments:

- Request a final set of engine simulation data if necessary.

Task 2: Conduct Simulation Trials:

- UNO will complete any requested engine simulation runs.

Task 3: Develop Real-time Neural Network Learning Techniques:

- Complete the development of a real-time artificial neural network learning system based on each of the selected networks.

Task 4: Conduct Neural Network Training Trials:

- Design and implement a computer program to produce a stream of simulated engine parameter values, given the UNO-generated engine simulator output requested as part of task 1. The program will emulate real-time implementation as if each input data record were being acquired on-line from a ship's engine monitoring system.

- Begin training and evaluation of differentiable CMAC- and DYSTAL-based real-time learning systems.

Explanation of Changes to Schedule:
No changes were made to the schedule this quarter.

Input File Specification
Artificial Neural Network Training / Testing

General Specifications: An input file for online training / testing will be a simulated record of engine parameter values sampled at 30 second intervals. It will be

1) An ASCII file with matrix form, where the
2) First row in the file is devoted to column headers, and the
3) Column headers are separated by commas, and the
4) Column entries are ASCII floating point separated by commas.

Matrix Contents:

Column Number	Column Header	Units	Description of Column Contents
1	Time	Min.	Simulated Running Time. Time=0.0 at start of simulation.
2	%MCR	%	Percent of Maximum Continuous Rating
3	U100	rpm	RPM
4	U101	mm	RACK POSITION
5	U152	psig	LB CHARGE AIR PRESSURE
6	U154	degF	LB CHARGE AIR MANIFOLD TEMP
7	U161	degF	EXH GAS TEMP - CYL A-5
8	U162	degF	EXH GAS TEMP - CYL A-4
9	U163	degF	EXH GAS TEMP - CYL A-3
10	U164	degF	EXH GAS TEMP - CYL A-2
11	U165	degF	EXH GAS TEMP - CYL A-1
12	U171	degF	LB TURBO INLET GAS TEMP
13	U173	degF	RB TURBO EXH GAS INLET TEMP
14	U176	rpm	LB TURBOCHARGER RPM
15	U180	psig	FUEL OIL INLET PRESSURE
16	U194	kbhp	BRAKE HORSEPOWER
17	U372	kshp	SHAFT HORSEPOWER
18	U978	psig	LB TURBO INLET GAS PRESSURE

Experimental Simulation Plan and Report

Purpose: This document will accumulate requests for diesel engine simulation and reports of their completion.

General Description of Simulation Data Required: The project's main objectives are to develop artificial neural network learning techniques that can detect changes in engine operating characteristics over time, and to apply these techniques to learn the relationships among key engine variables. To accomplish these objectives requires training data that consist of fabricated time histories of engine parameter measurements. Because other engine parameters vary with engine power, for example, these histories must span a variety of values of engine power to represent these relationships completely. The histories will therefore conceptually consist of values of many engine parameters calculated under simulated steady state conditions concatenated with values of those same parameters calculated under simulated transient conditions.

Simulation Request #1: Requested by MACSEA Tuesday, July 30, 1996
Completed by UNO Monday, August 5, 1996

Comment: The purpose of this first run is simply to create a small set of example output files. MACEA will examine these outputs for the purpose of designing the front end software required to conduct artificial neural network training trials.

Steady State Simulation:

Control Parameter: Engine Power (specified as percent of MCR power)
Values: MCR, 75% MCR, 50% MCR

Output Parameter: Exhaust gas temperature for each cylinder as a function of crank angle.

Transient Simulation:

Control Parameter: Load vs. time profile
Value: MCR transition to 75% MCR until steady state, then transition to 50% MCR until steady state

Output Parameter: Exhaust gas temperature for each cylinder as a function of time until steady state convergence.

Simulation Request #2: Requested by MACSEA Tuesday, December 10, 1996

Steady State Simulation:

Control Parameter: Engine Load specified as percent of Maximum Continuous Rating (MCR)

Values:
MCR,
95% MCR,
90% MCR,
85% MCR,
80% MCR,
75% MCR,
70% MCR,
65% MCR,
60% MCR,
55% MCR, and
50% MCR

Output Parameters: Averages only; all elements of the table below in one comma-separated or tab-separated ASCII file.

Table 1.

Column Number	Column Header	Units	Description of Column Contents
1	Time	Min.	Simulated Running Time. Time=0.0 at start of simulation.
2	%MCR	%	Percent of Maximum Continuous Rating
3	U100	rpm	RPM
4	U101	mm	RACK POSITION
5	U152	psig	LB CHARGE AIR PRESSURE
6	U154	degF	LB CHARGE AIR MANIFOLD TEMP
7	U161	degF	EXH GAS TEMP - CYL A-5
8	U162	degF	EXH GAS TEMP - CYL A-4
9	U163	degF	EXH GAS TEMP - CYL A-3
10	U164	degF	EXH GAS TEMP - CYL A-2
11	U165	degF	EXH GAS TEMP - CYL A-1
12	U171	degF	LB TURBO INLET GAS TEMP
13	U173	degF	RB TURBO EXH GAS INLET TEMP
14	U176	rpm	LB TURBOCHARGER RPM
15	U180	psig	FUEL OIL INLET PRESSURE
16	U194	kbhp	BRAKE HORSEPOWER
17	U372	kshp	SHAFT HORSEPOWER
18	U978	psig	LB TURBO INLET GAS PRESSURE

Transient Simulations:

Control Parameter: Load vs. time profile

Value: All transitions, up and down between the %MCR loads listed above. Time for each transition to be 1 second for each 1% MCR change. All runs to continue until steady state. There will be a total of 110 transient simulations.

Output Parameters: 30 second moving averages only of all parameters in Table 1. All output to be collected into a single comma-separated or tab-separated ASCII file.

Classification of Artificial Neural Network Architectures
For Automated Real Time On-line
Function Estimation and Auto-Associative Memory

The name of each artificial neural network architecture studied is listed below as often as appropriate. Categories are not mutually exclusive.

Spatially-Localized Learning Techniques
- Differentiable Cerebellar Model Arithmetic Computer
- Dynamically Stable Learning Neural Network
- General Regression Neural Network
- K-Nearest Neighbor Neural Network
- K-Nearest Neighbor Radial Basis Function Neural Network
- Multiple Resolution Hierarchy Neural Network
- Probabilistic Neural Network
- Radial Basis Function Neural Network

Memory-Conservative Learning Techniques
- Differentiable Cerebellar Model Arithmetic Computer
- Dynamically Stable Learning Neural Network
- Dynamic Radial Basis Function Neural Network with Locally-Tuned Units
- Functional Link Neural Network
- Learning Vector Quantization
- Multiple Resolution Hierarchy Neural Network
- Multiple Layer Perceptron Trained with Backpropagation
- Probabilistic Neural Network with Maximum A Posteriori Training
- Probabilistic Restricted Coulomb Energy Neural Network

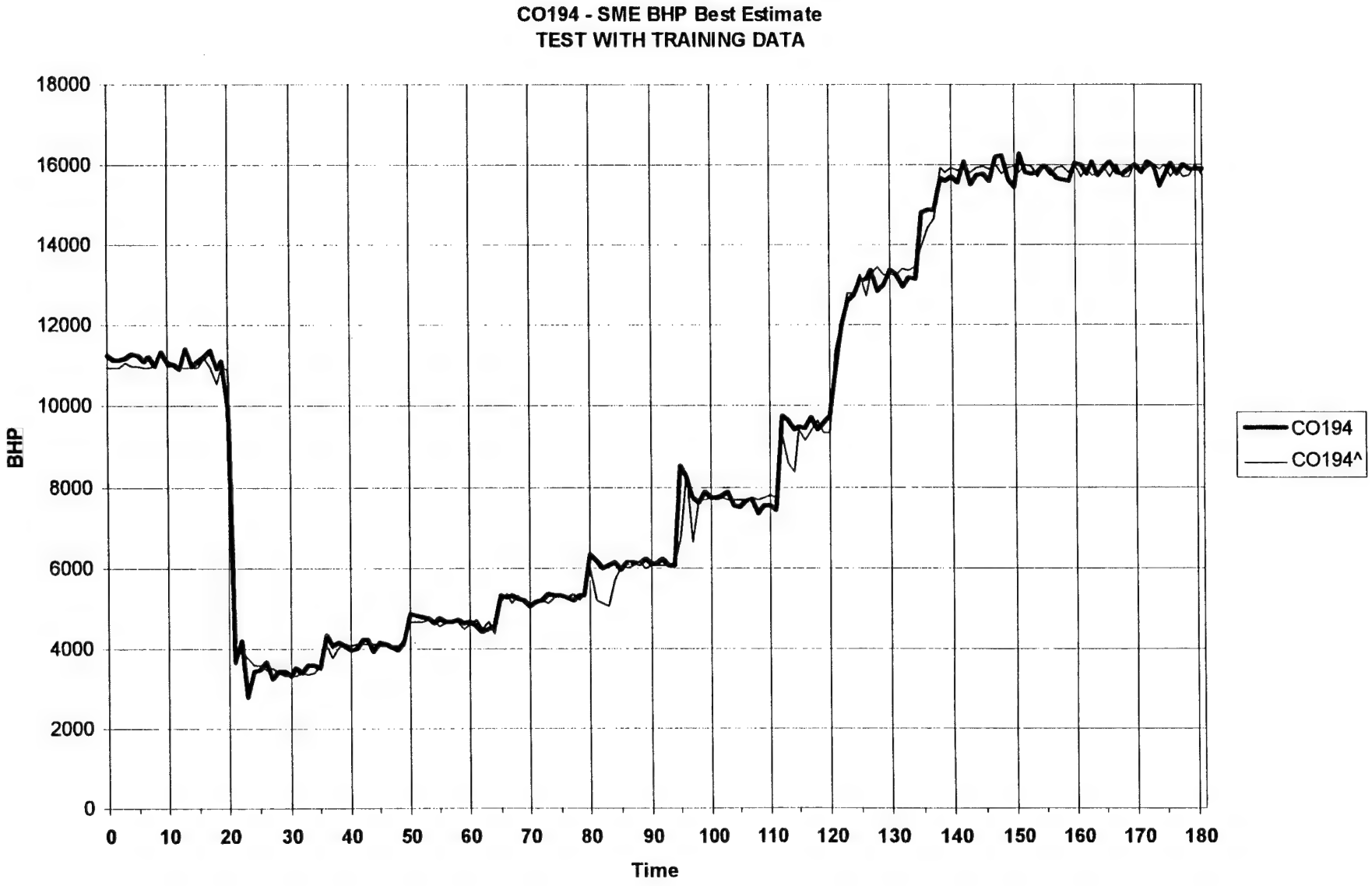
Real Time Learning Techniques
- Differentiable Cerebellar Model Arithmetic Computer
- Dynamically Stable Learning Neural Network
- Functional Link Neural Network
- General Regression Neural Network
- K-Nearest Neighbor Neural Network
- K-Nearest Neighbor Radial Basis Function Neural Network
- Probabilistic Neural Network
- Probabilistic Neural Network with Maximum A Posteriori Training
- Probabilistic Restricted Coulomb Energy Neural Network
- Radial Basis Function Neural Network

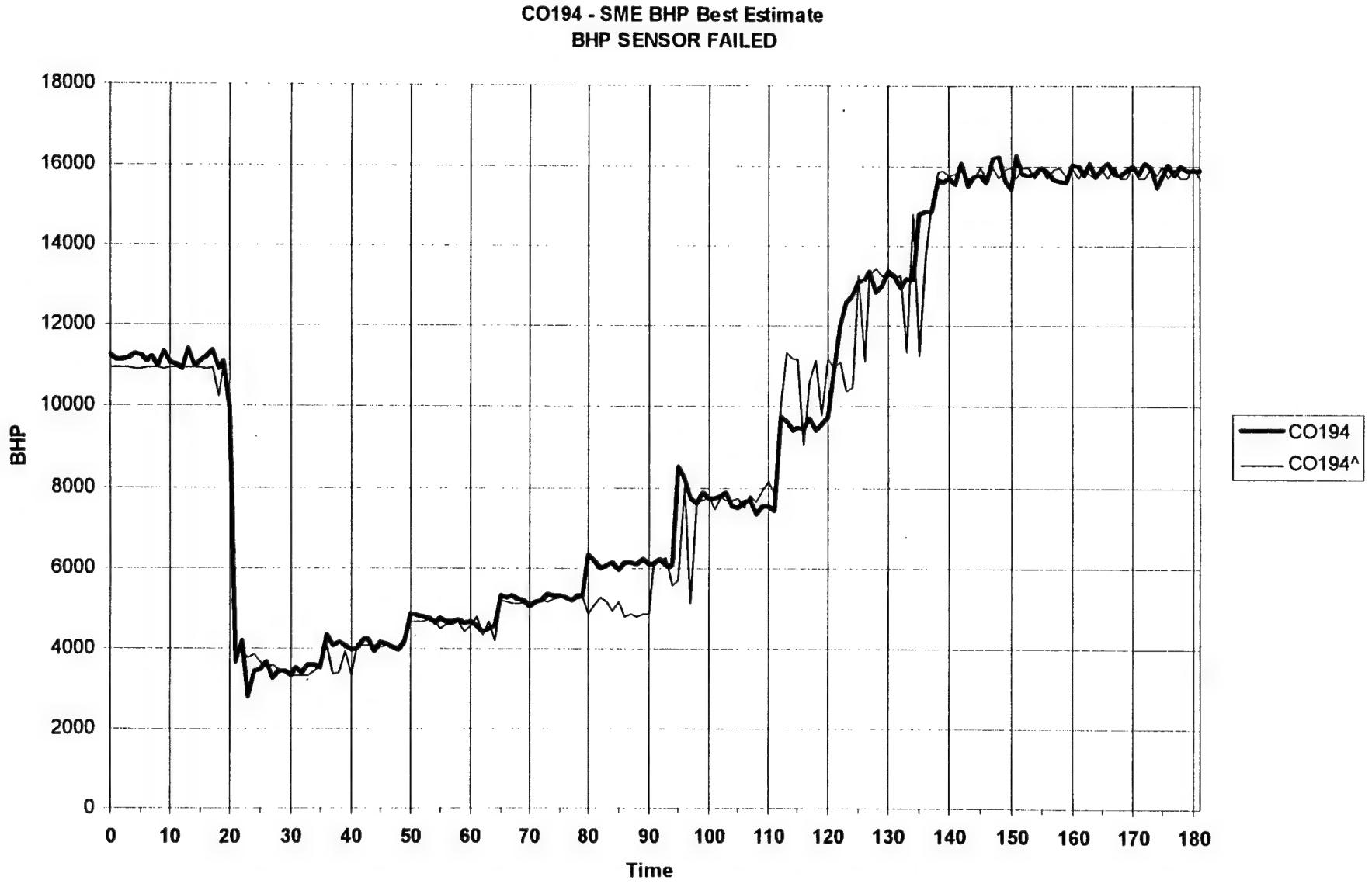
Learning Techniques with Few User-Adjustable Parameters

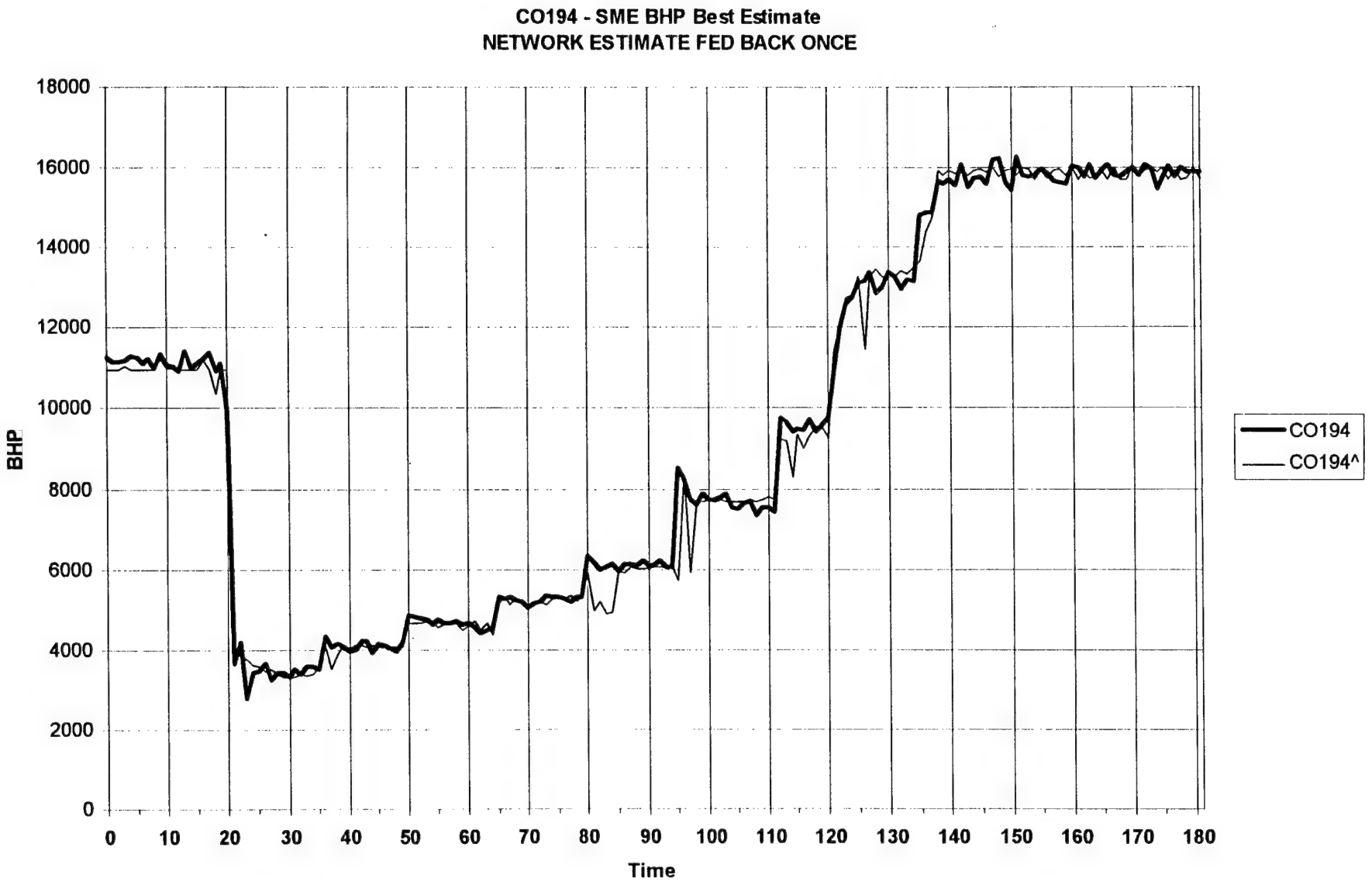
- Differentiable Cerebellar Model Arithmetic Computer
- Dynamic Radial Basis Function Neural Network with Locally-Tuned Units
- Dynamically Stable Learning Neural Network
- General Regression Neural Network
- K-Nearest Neighbor Neural Network
- K-Nearest Neighbor Radial Basis Function Neural Network
- Learning Vector Quantization
- Multiple Resolution Hierarchy Neural Network
- Probabilistic Neural Network
- Probabilistic Neural Network with Maximum A Posteriori Training
- Probabilistic Restricted Coulomb Energy Neural Network
- Radial Basis Function Neural Network

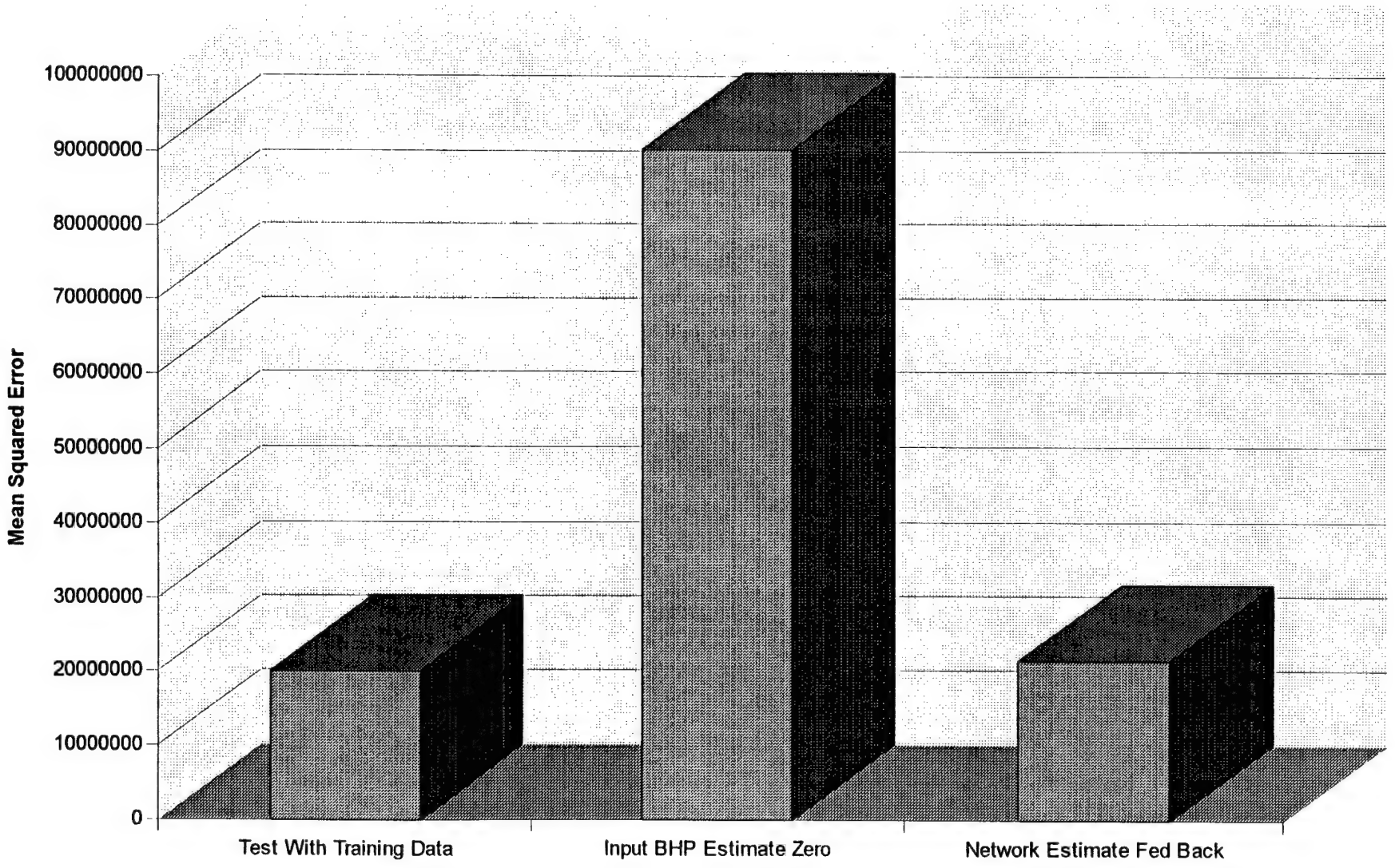
Local Memory-Conservative Real Time Parameter-Scarce Learning Techniques

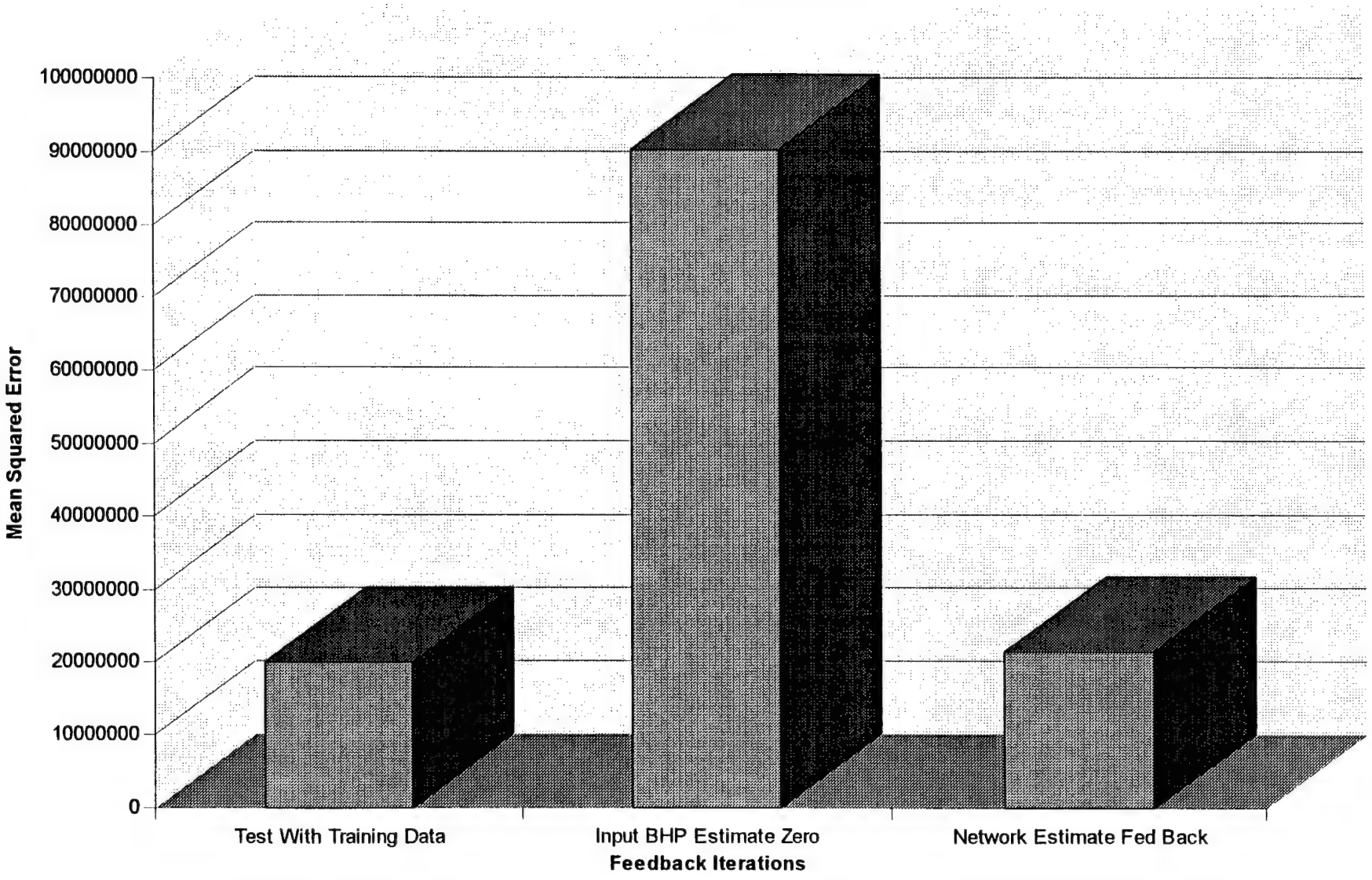
- Differentiable Cerebellar Model Arithmetic Computer
- Dynamically Stable Learning Neural Network


CO194 - SME BHP Best Estimate
TEST WITH TRAINING DATA
BHP
Time
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
CO194
CO194^

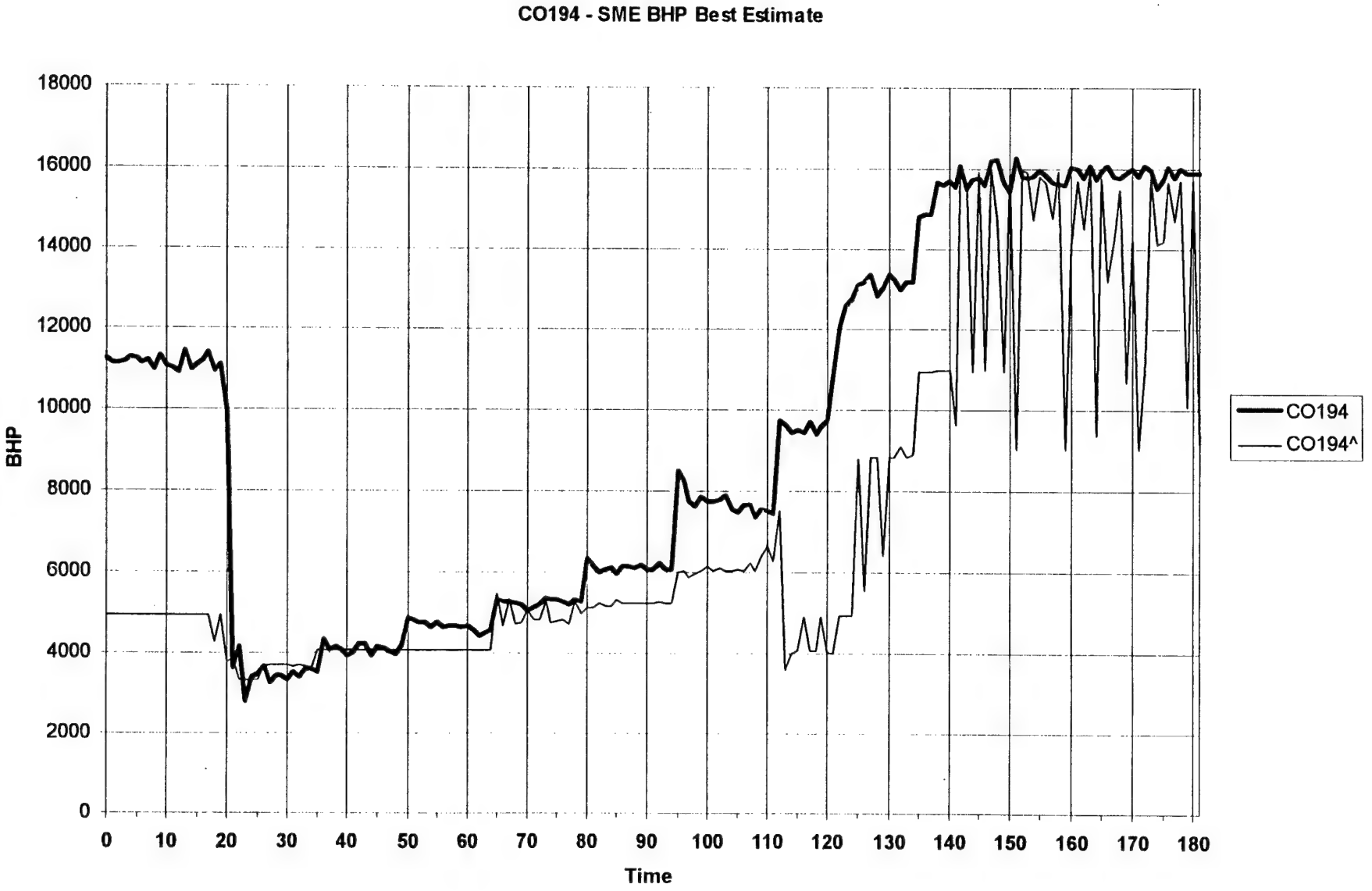

CO194 - SME BHP Best Estimate
BHP SENSOR FAILED
BHP
Time
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0 10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180
CO194
CO194^


CO194 - SME BHP Best Estimate
NETWORK ESTIMATE FED BACK ONCE
BHP
Time
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
CO194
CO194^

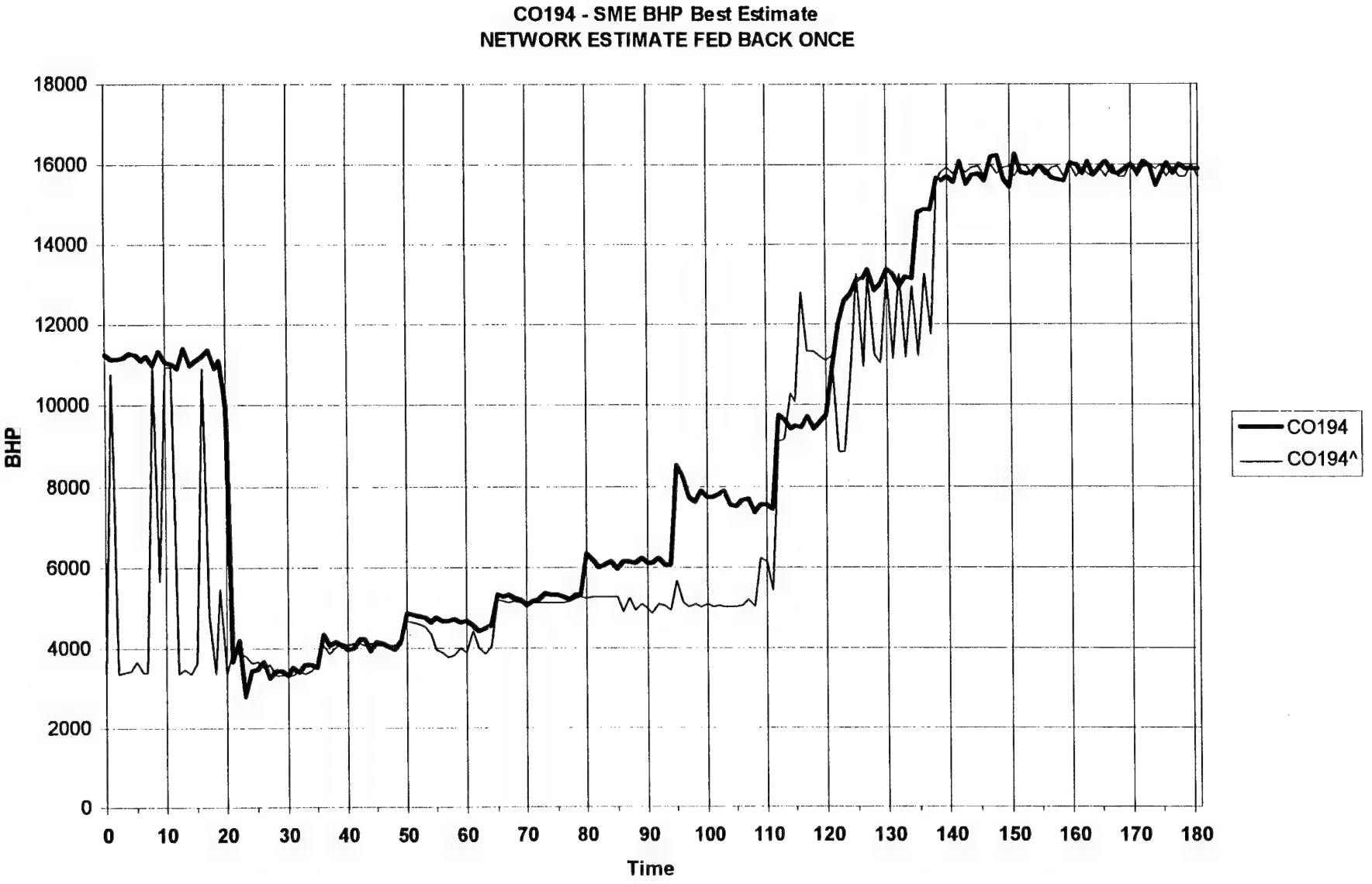

Mean Squared Error
100000000
90000000
80000000
70000000
60000000
50000000
40000000
30000000
20000000
10000000
0
Test With Training Data
Input BHP Estimate Zero
Network Estimate Fed Back


100000000
90000000
80000000
70000000
60000000
50000000
40000000
30000000
20000000
10000000
0
Mean Squared Error
Test With Training Data
Input BHP Estimate Zero
Network Estimate Fed Back
Feedback Iterations

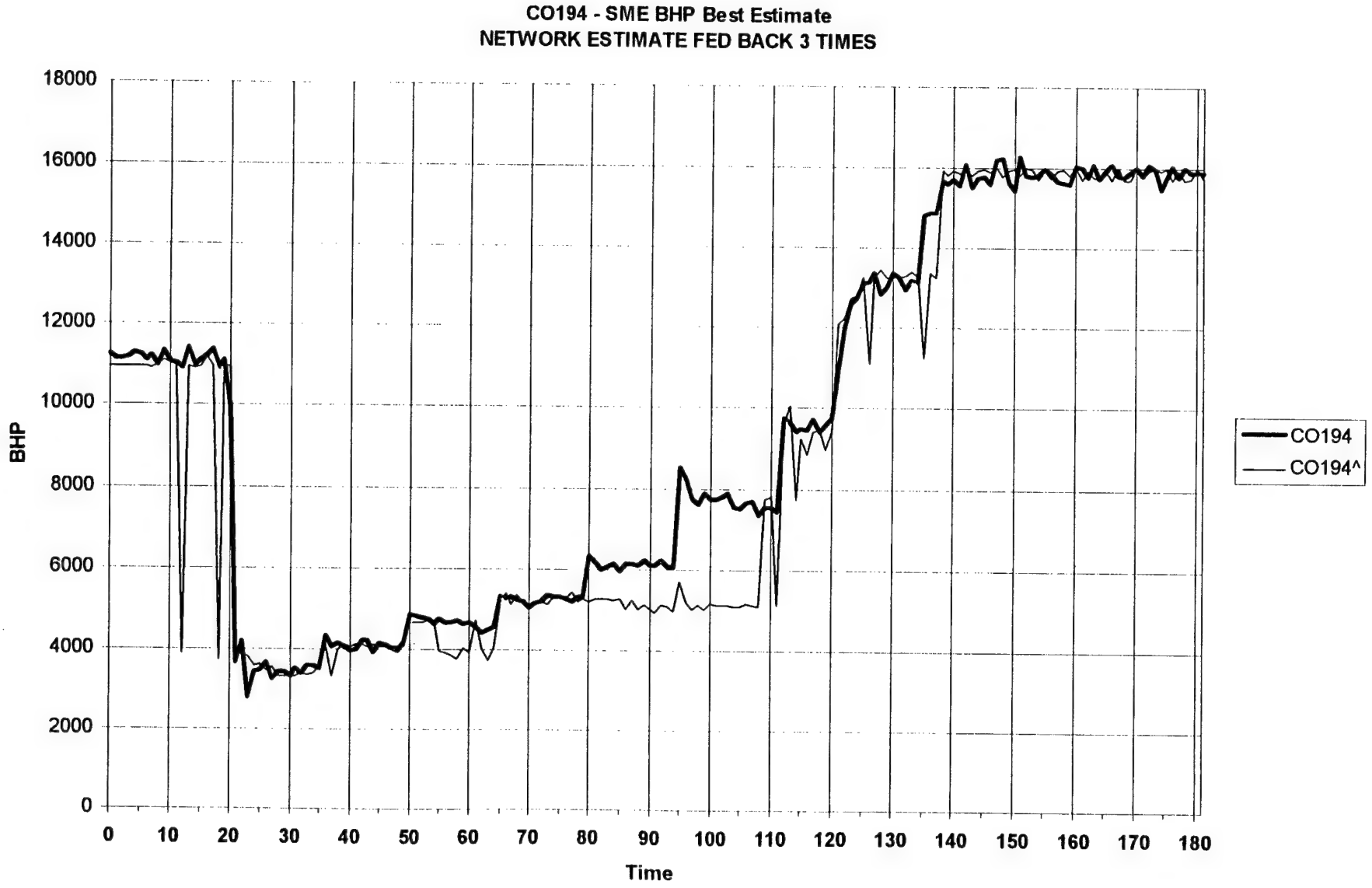
BHP SENSOR AND 7 OTHERS FAILED



BHP SENSOR AND 7 OTHERS FAILED

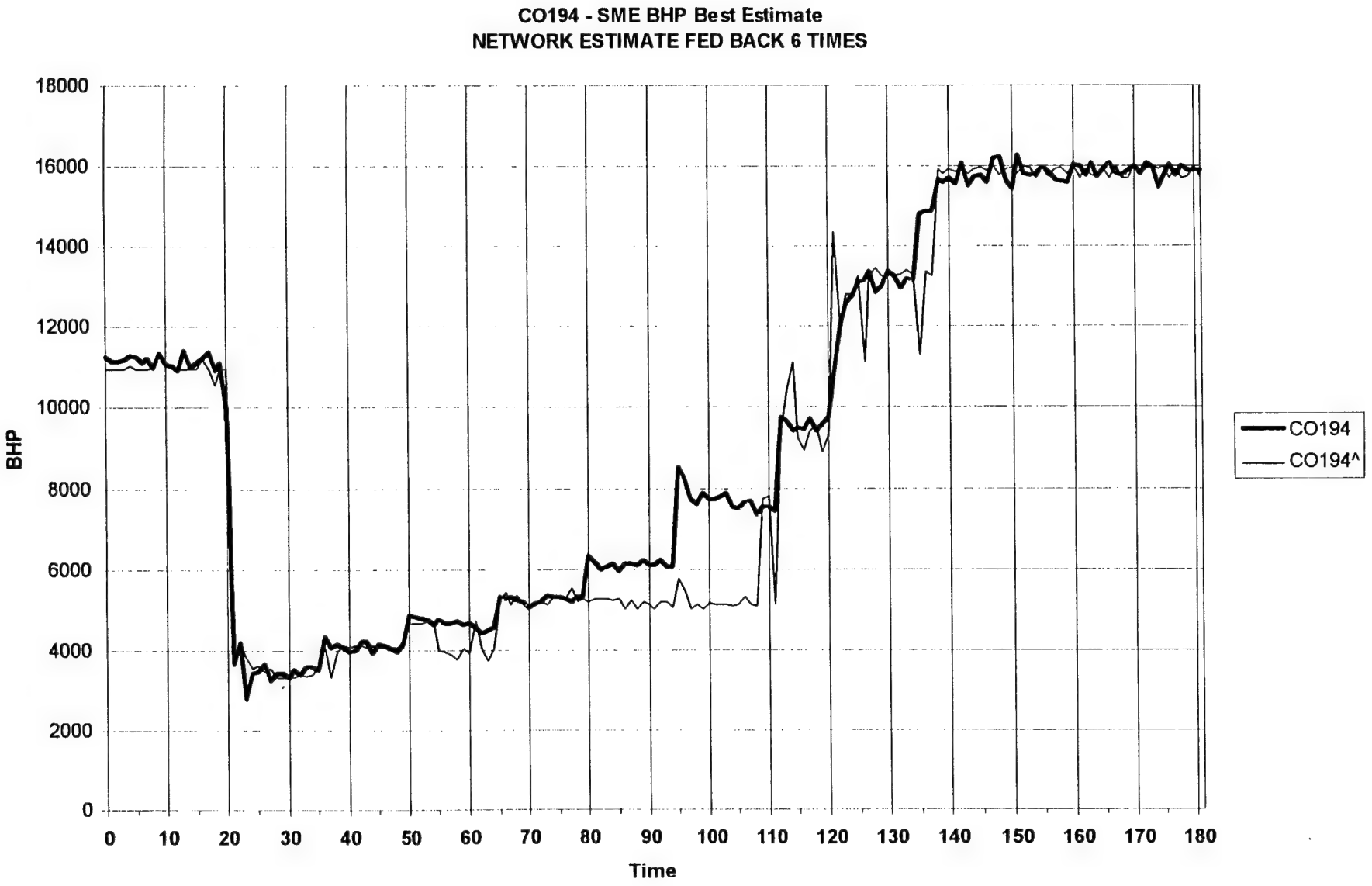


BHP SENSOR AND 7 OTHERS FAILED

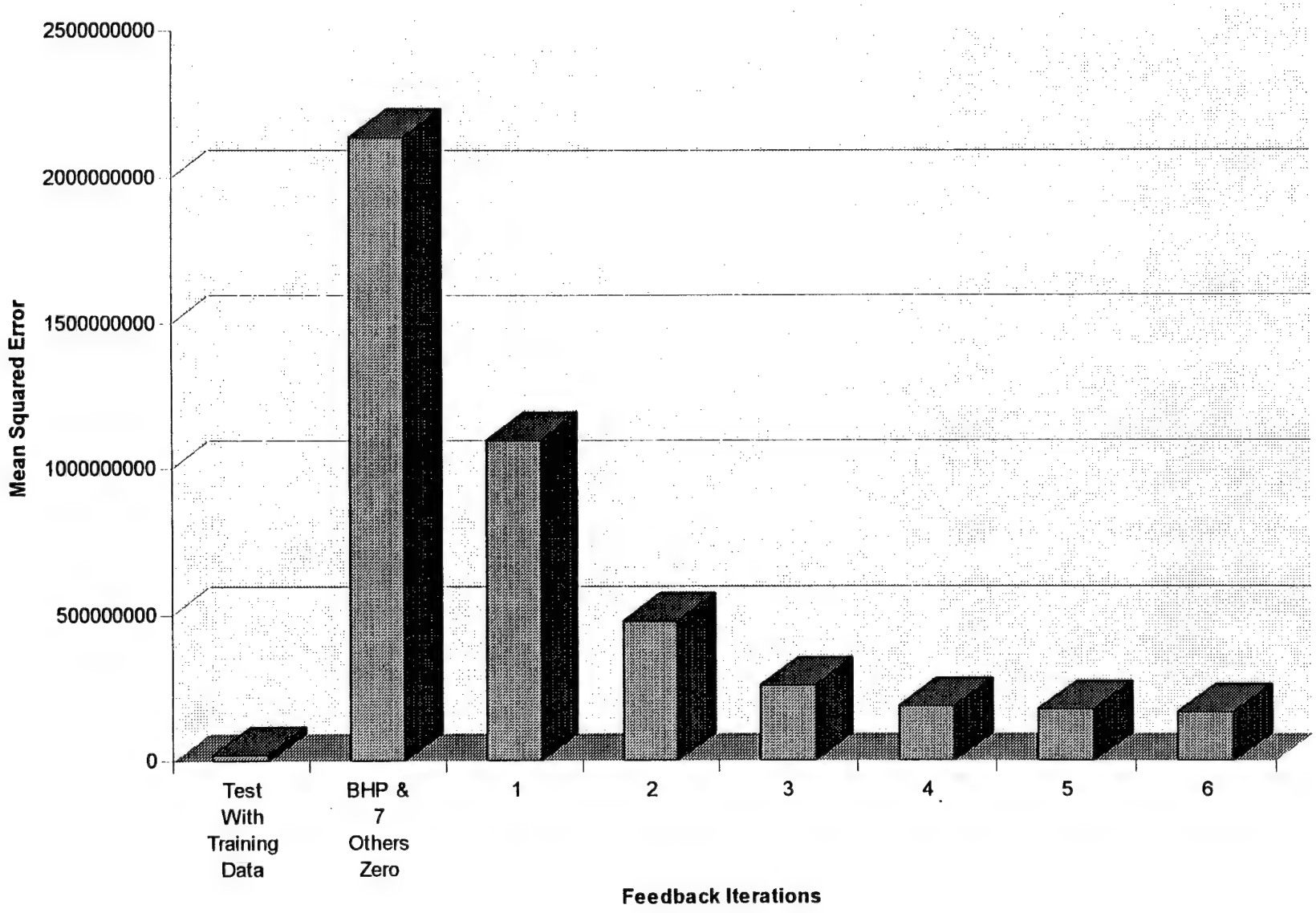


T-21

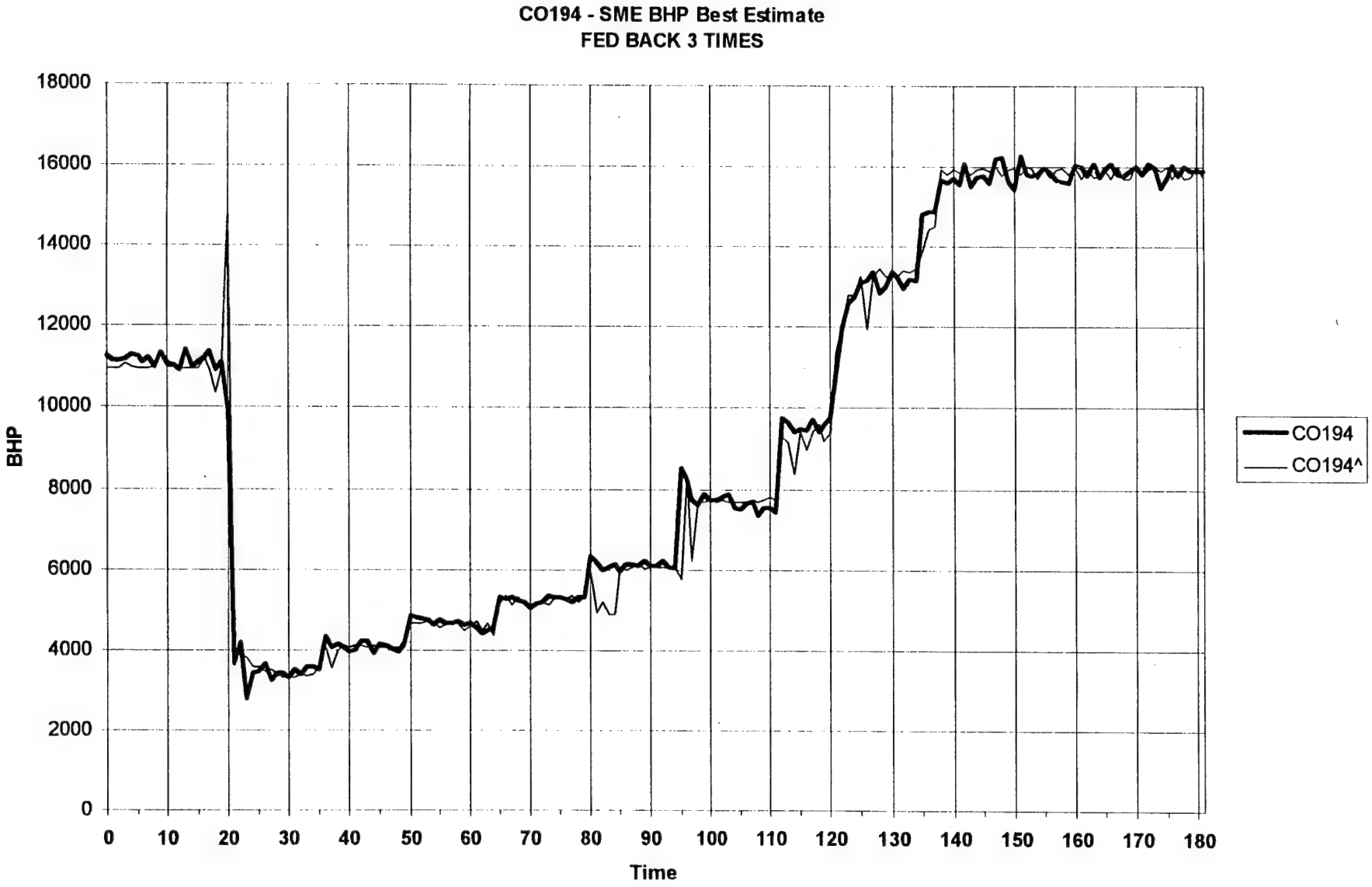
BHP SENSOR AND 7 OTHERS FAILED



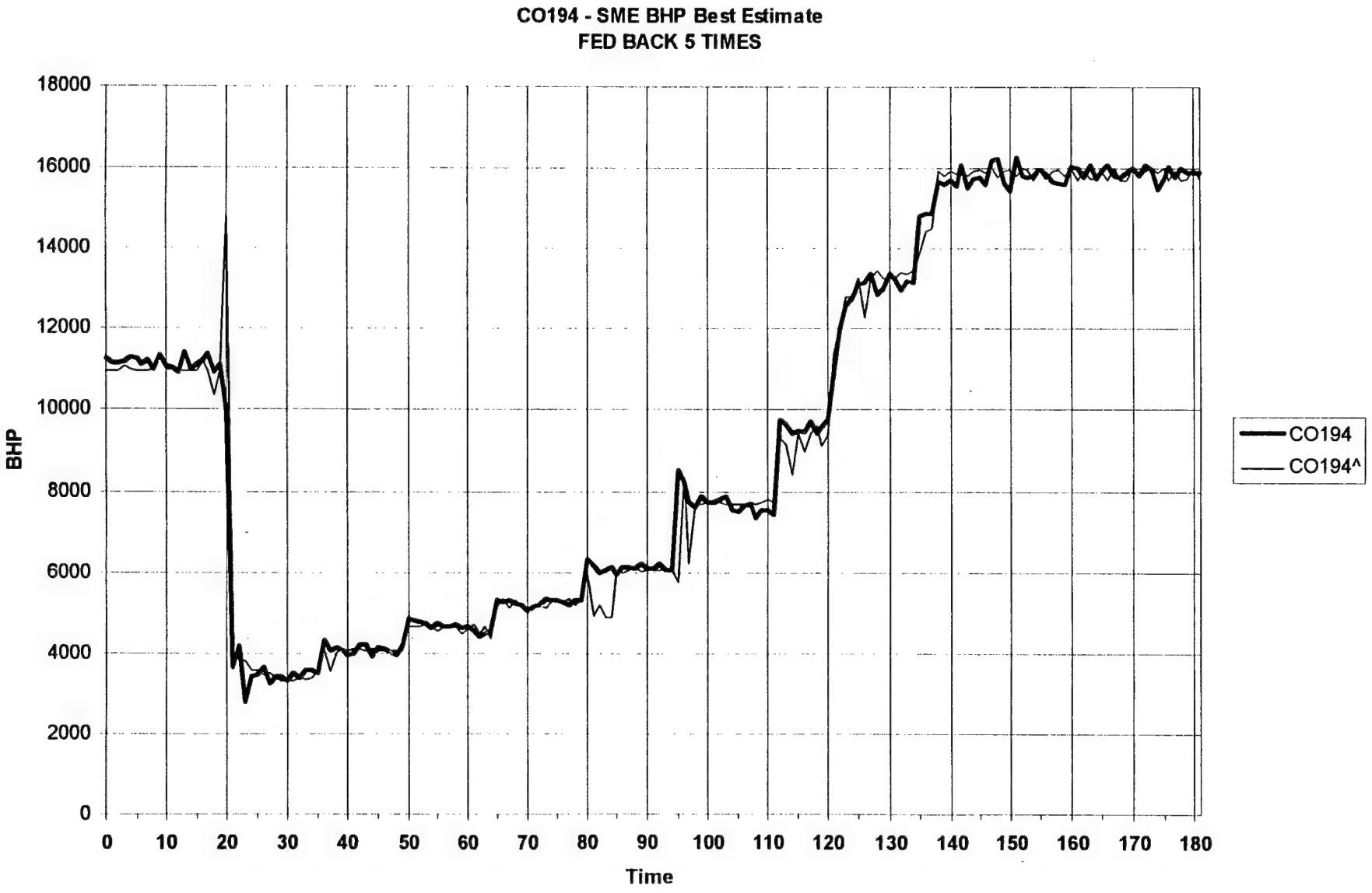
BHP SENSOR AND 7 OTHERS FAILED



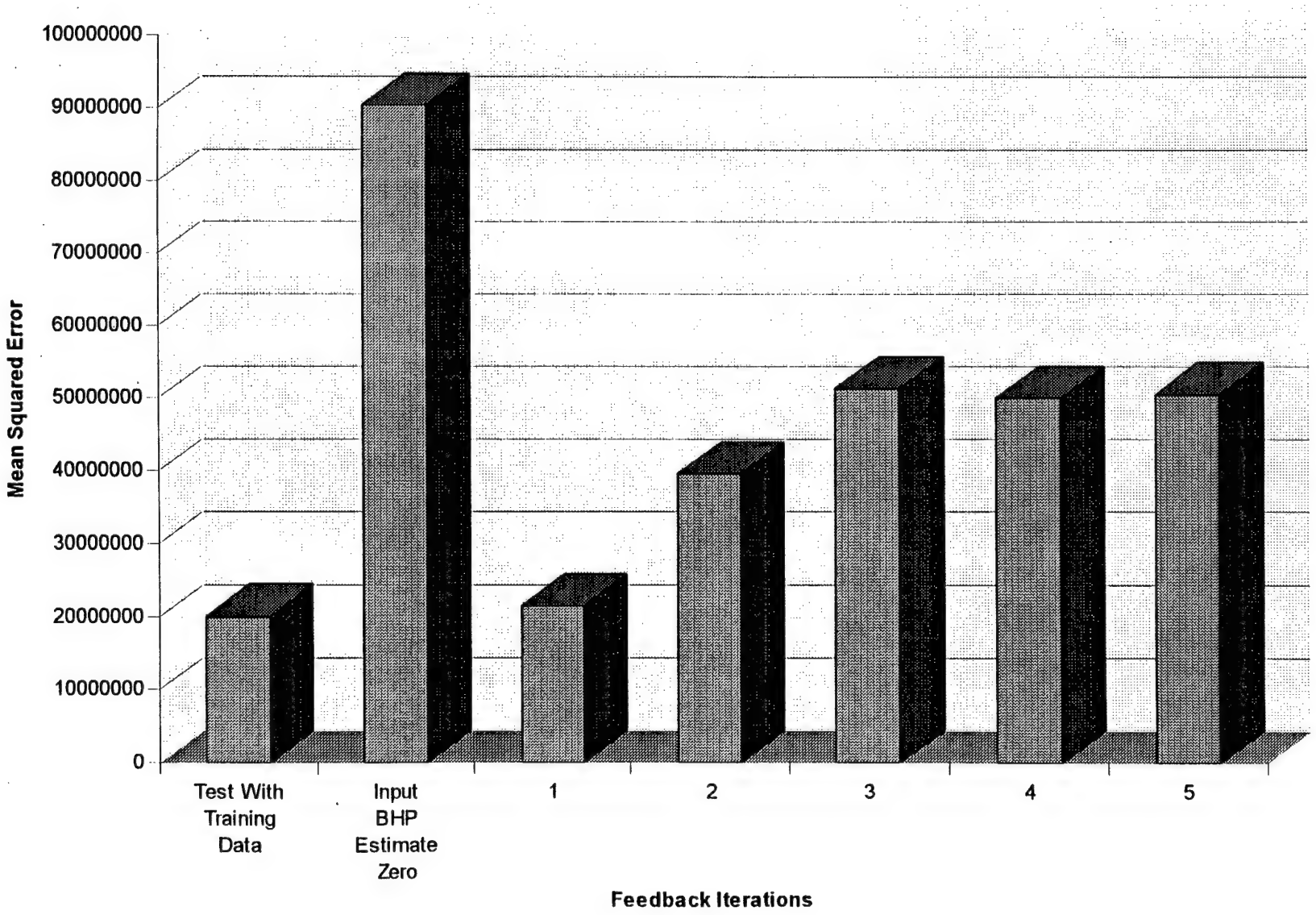
BHP SENSOR FAILED



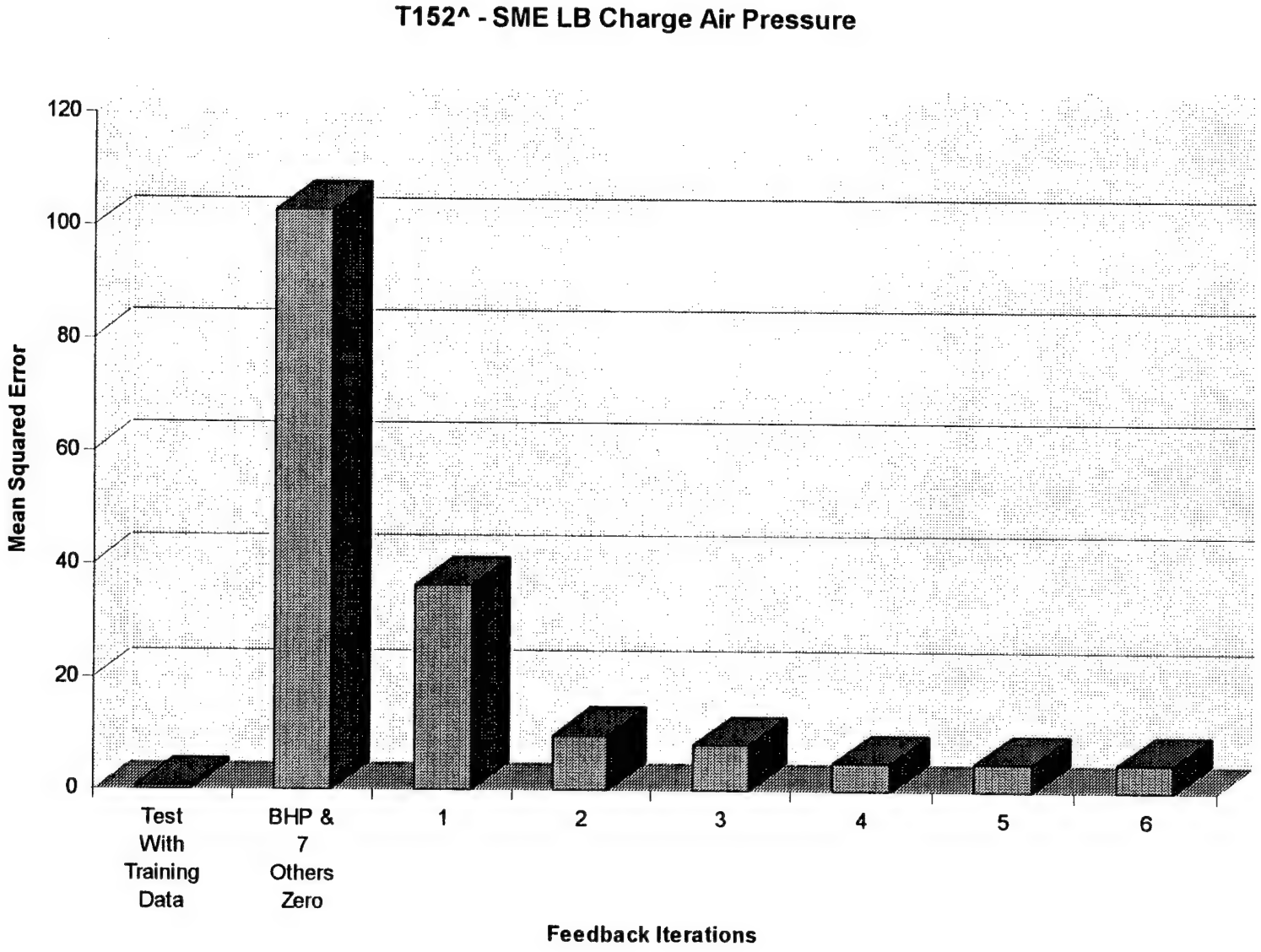
BHP SENSOR FAILED



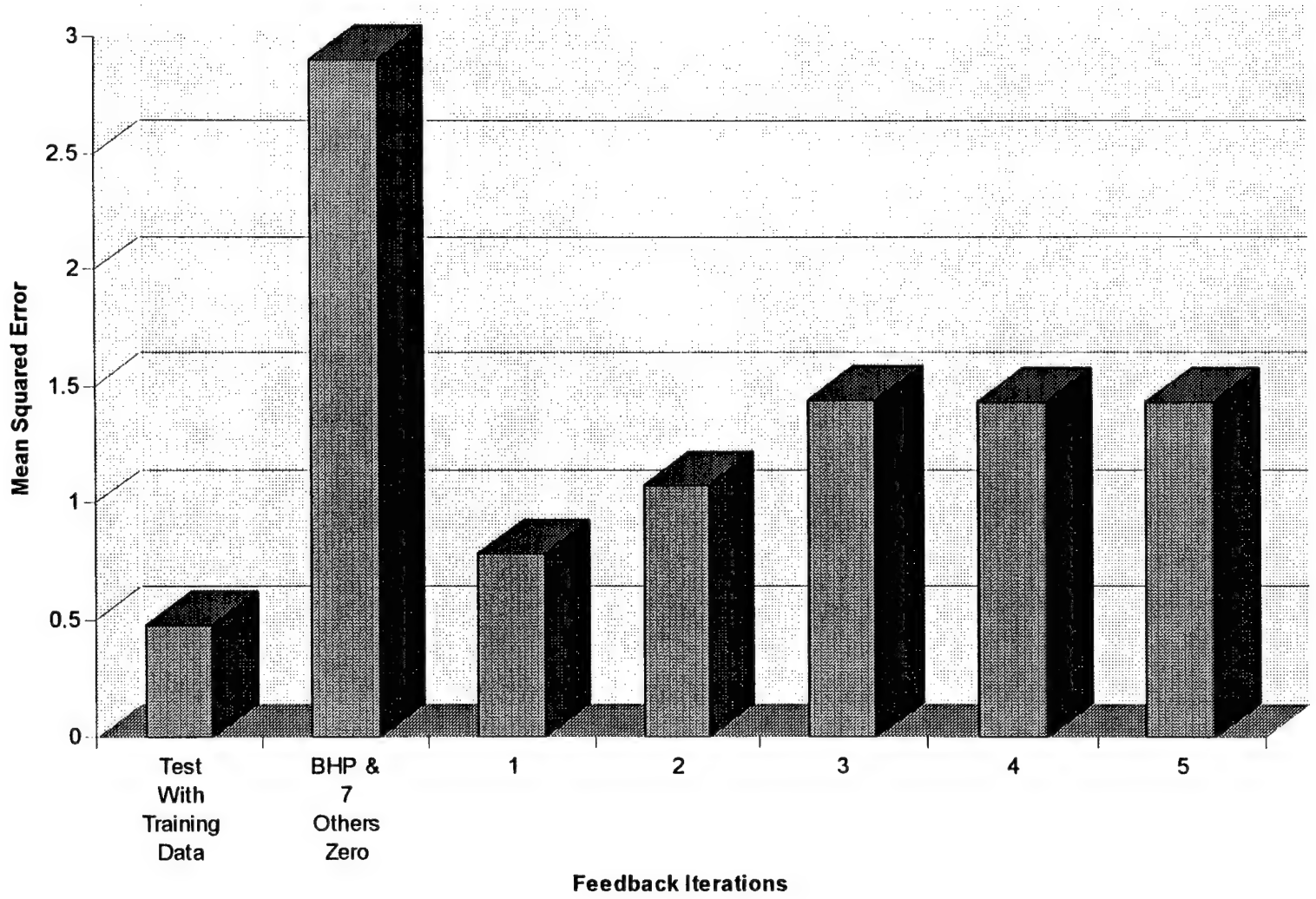
BHP SENSOR FAILED



BHP SENSOR & 7 OTHERS FAILED
NETWORK ESTIMATE OF VALID SENSOR DATA



BHP SENSOR FAILED
NETWORK ESTIMATE OF VALID SENSOR DATA



Time Line MACSEA Quarterly Report #2

Schedule	Status		Jun-96				Jul-96				Aug-96				Sep-96				Oct-96				Nov-96				Dec-96				Jan-97				Feb-97				Mar-97				Apr-97				May-97			
	Start	Final	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
1. Design Simulation Experiments	6/1/96	1/31/97																																															
	6/1/96	1/31/97																																															
2.0 Conduct Simulation Trials	8/1/96	2/20/97																																															
	8/1/96	2/20/97																																															
3.0 Develop Machine Learning Techniqu	7/21/96	1/31/97																																															
	7/21/96	1/31/97																																															
4.0 Conduct Machine Learning Trials	10/1/96	4/30/97																																															
	10/1/96	4/30/97																																															
5.0 Project Management/Reporting	5/1/97	5/30/97																																															
	5/1/97	5/30/97																																															

New
Old
New
Old
New
Old
New
Old
New
Old

APPENDIX U

SIMULATION OF MOBILE OFFSHORE BASE PROJECT

Principle Investigator:

John Cardner
Gulf Coast Region Maritime Technology Center
Orange, Texas Site

University of New Orleans
New Orleans, LA 70148

U.1 PROJECT SYNOPSIS

The design (preliminary, detail, and contract) phase of the mobile offshore base project was awarded by the U. S. Navy to McDermott Shipbuilding, Inc. (MSI). The mobile offshore base is made up of five 1,000-foot single base units that are connected to each other and is designed to support up to 20,000 on-board military personnel, aircraft landing and takeoff, and derives its mobility from self-propelling hulls.

The GCRMTC Orange site of the University of New Orleans was issued a procurement order to perform services in support of simulation-based activities on the preliminary design phase of the mobile offshore base. As outlined in the procurement order, the scope of work calls for MSI to be provided with a dynamic, physics-based simulation of the mobile offshore base in various sea states; animation and visualization are integral elements of the center's scope of work on this project. Each phase of the scope of work adds incremental complexities resulting in a real time, physics-driven, photo-realistic mechanical simulation of the mobile offshore base in an artificial ocean. Additionally, the animated storyboard will portray the docking of two single base units of the mobile offshore base and will feature auxiliary ships and cargo handling routines. The understanding of these mechanical sequences are considered critical to the detail design phase of the project.

U.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED: $150,000

Note: Project funded from external subcontract; additional funds of $96,899 will be released in early February 1997.

FUNDS REMAINING: $104,821

U.3 ACCOMPLISHMENTS DURING CURRENT QUARTER

TASK I: WALK-THROUGH/FLY-THROUGH

1. Purchased WAMIT, Coryphaeus Maritime Module, and ADAMS Animation software for use in this phase of the project. Additionally, modifications to develop interface from Coryphaeus to ADAMS software was completed by a third party vendor.

2. Visualization of mobile offshore base in dVise and Alias software was completed, edited on Beta deck, output to videotape, and delivered to MSI.

3. Visualization of mobile offshore base including landing and take-off of C-130 and C-17 in dVise and Alias software was completed, edited on Beta deck, output to videotape, and delivered to MSI.

TASK II: INDUCED MOBILE OFFSHORE BASE MOTION VISUALIZATION

1. Visualized animation of flight paths on wave-induced motions of the mobile offshore base in different sea states in dVise software.

2. Participated in Phase I of technology transfer training in the ADAMS mechanical software. Five center personnel were joined by four engineers from McDermott during this training session conducted at the center by the developers of the ADAMS software, Mechanical Dynamics Inc.

U.4 PROPOSED ACTIVITIES FOR NEXT QUARTER

TASK III: INDUCED MOTION OF MOBILE OFFSHORE BASE AND AUXILIARY SHIPS

The same technology applied in Task II will be applied to response amplitude operators calculated by WAMIT for the mobile offshore base with two different auxiliary ships (supply and landing craft) in the vicinity. Phase II of the technology transfer training in ADAMS is scheduled for the same participants as in Phase I.

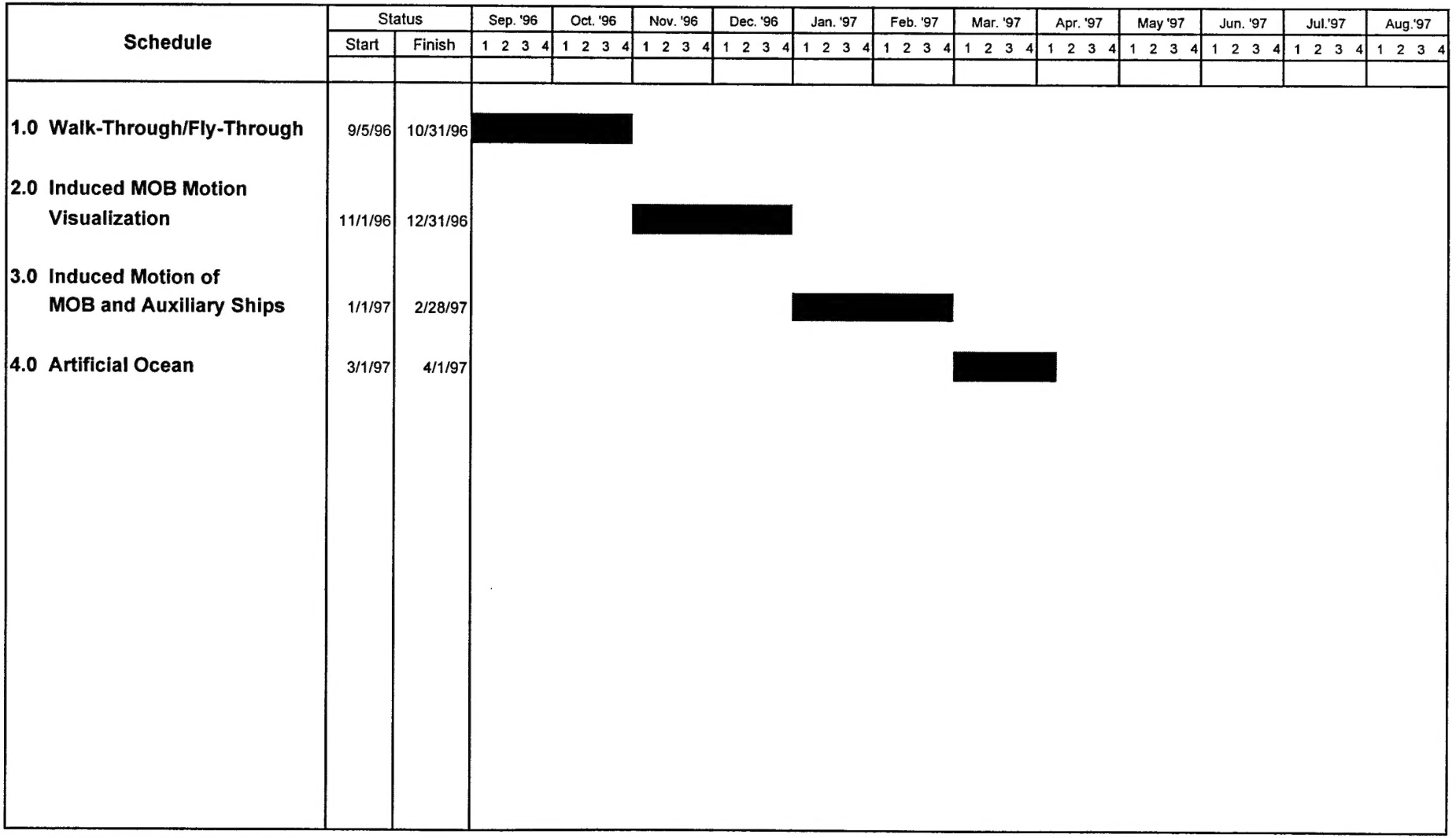
TASK IV: ARTIFICIAL OCEAN

A realistic visualization of the ocean surface will be created and synchronized with the motion of the vessels from Tasks II and III. Phase III of the technology transfer training in ADAMS is scheduled for the same participants as in Phases I and II.

U.5 COLLABORATIVE EFFORTS

	CURRENT QTR.	YTD
$ VALUE OF SERVICES FROM INDUSTRY:		
In-Kind Services:	N/A	N/A
Actual Funds:	N/A	N/A
$ VALUE OF SERVICES FROM GOVERNMENT:		
In-Kind Services:	N/A	N/A
Actual Funds:	N/A	N/A
NUMBER OF SIGNIFICANT CONTACTS:		
Industry:		N/A
Academic:		N/A
Government:		N/A

Simulation of Mobile Offshore Base Project



APPENDIX V

AVONDALE ROLL-ON/ROLL-OFF (RORO) PROJECT

Principle Investigator:

Stuart Haller
Gulf Cost Region Maritime Technology Center
Orange, Texas Site

University of New Orleans
New Orleans, LA 70148

V.1 PROJECT SYNOPSIS

The Avondale Roll-On/Roll-Off (RORO) project is a MARITECH sponsored project with the goal of investigating and improving pre-contract ship design and its related processes. The principal contributing members of this project are Avondale Industries, Inc., Intergraph Corporation, General Dynamics Electric Boat, and the Gulf Coast Region Maritime Technology Center (GCRMTC).

The major thrust of this endeavor is to use the Integrated Product and Process Development (IPPD) methodology to reduce the cost of acquiring and operating a ship over its lifetime. A subset of IPPD is simulation-based design (SBD) for which the GCRMTC will provide the technological expertise needed to successfully realize this component of IPPD. This project is scheduled to last two years at an estimated project cost of $4.6 million dollars, of which approximately $145,237 is scheduled to be committed to the GCRMTC. Current project expenditures are continuing under the pre-award cost phase for all participants in this project. Consequently, the full scope of the center's participation in this project has been delayed until funds are released by MARITECH.

A major goal of the RORO endeavor is to ensure that the processes and tools relative to IPPD are practically and effectively used by applying them to the RORO ship, including the implementation of an Integrated Product Data Environment (IPDE). IPDE is an information system environment that ensures that the data developed during the design process is used throughout the life of the ship from design, through engineering, procurement, production, testing, and maintenance. One of the cornerstones of the IPDE is the development of the product model, which is a 3-dimensional geometry model of the ship with associated product attributes containing the detailed product information. As the post-award scope of work is developed, GCRMTC's role relative to IPDE will be more clearly defined.

V.2 BUDGET STATUS

TOTAL AMOUNT BUDGETED: $145,237

Note: Project funded from external subcontract; budgeted amount includes pre-award costs.

FUNDS REMAINING: $120,719

V.3 ACCOMPLISHMENTS DURING CURRENT QUARTER

TASK I: PRE-AWARD ACTIVITIES

1. Identified and formed Integrated Product and Process Development teams from principal and contributing members of the RORO project. Team membership formation was based on strategic and functional mix of people skills.

2. Team members participated in a variety of team building exercises and planning sessions.

V.4 PROPOSED ACTIVITIES FOR NEXT QUARTER

TASK II: POST-AWARD INITIAL ACTIVITIES

1. Continuation of IPPD team dynamics training.
2. CAD/CAM training to be conducted by Intergraph Corporation.
3. Development of the first draft of the RORO design budget.
4. Simulation-based design modeling to begin.

V.5 COLLABORATIVE EFFORTS

	CURRENT QTR.	YTD
$ VALUE OF SERVICES FROM INDUSTRY:		
In-Kind Services:	N/A	N/A
Actual Funds:	N/A	N/A
$ VALUE OF SERVICES FROM GOVERNMENT:		
In-Kind Services:	N/A	N/A
Actual Funds:	N/A	N/A
NUMBER OF SIGNIFICANT CONTACTS:		
Industry:		N/A
Academic:		N/A
Government:		N/A